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ABSTRACT

An examination of Antarctica, from the first sightings to the heroic explorations of the late 18th and early 19th centuries to modern-day research, is presented in this book. Twelve chapters are as follows: (1) The search begins; (2) Whalers and sealers: bites and nibbles; (3) The new continent: first sight; (4) Wintering: the first party; (5) Exploration on land begins; (6) Coping with the basic problems; (7) Amundsen and Scott: the race for the Pole; (8) Shackleton: the survivor; (9) Mawson: the scientist-explorer; (10) The modern era; (11) Living and working in Antarctica: the new explorers; and (12) The future. A number of suggested activities are listed at the end of each chapter. Photos, maps, and illustrations appear throughout the book. There are four appendices: Appendix A--a chronological list of voyages of discovery and exploration; Appendix B--an index of wind pressure tabulation; Appendix C--a wind chill factor table; and Appendix D--a brief explanation of Antarctic seasons. A bibliography, a list of other resources, and a glossary conclude the volume. (DB)

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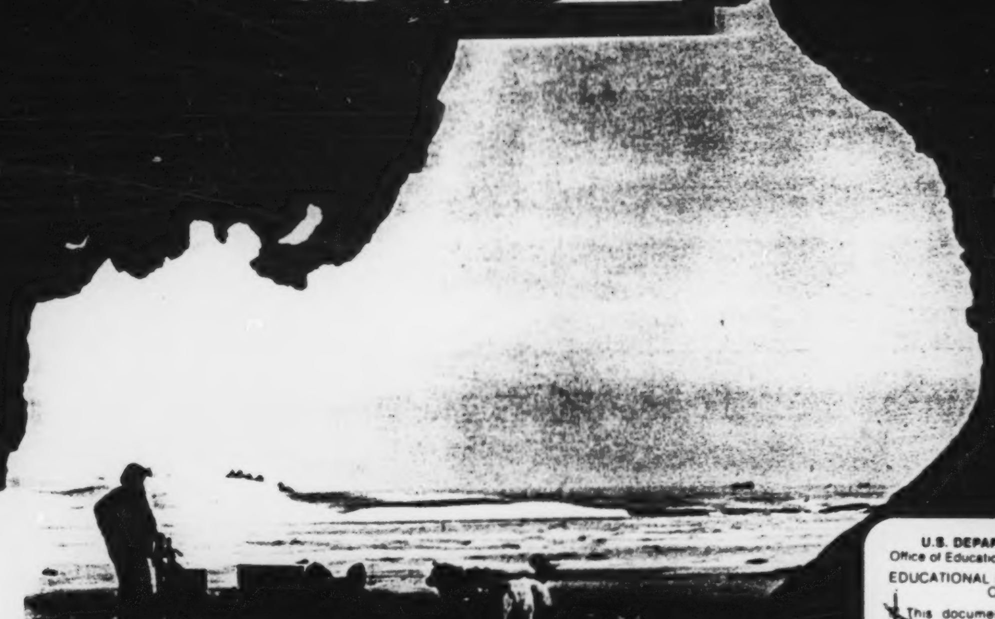
DISCOVERY & EXPLORATION



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DISCOVERY & EXPLORATION

Toss Gascoigne
Peter Collett

Curriculum
Development
Centre
Canberra
Australia

The author

Toss Gascoigne works as a school teacher in Hobart, Tasmania. He knew nothing about Antarctica when he was asked to write this book.

As his reading on the subject widened, he became fascinated by the explorers and their stories; and by the combination of determination, luck and solid preparation they needed to succeed in staying alive.

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The principal researcher for *Antarctica: Discovery and Exploration* was Peter Collett. The publishers are grateful to the following people and publishers for permission to reprint passages of text which appear in this book:

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DISCOVERY & EXPLORATION

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Scott's *Terra Nova* ploughs through a force ten gale in the "Fifties" (National Library of Australia - photo Herbert Ponting).

Why study Antarctica?

For the teacher

One of the aims of the Pacific Circle Consortium is the development of educational materials with an international perspective, particularly materials that take into account the half of the earth's surface covered by the Pacific Ocean. To the south of the Pacific lie the Southern Ocean and the great Antarctic continent.

There are many reasons for studying Antarctica. It is a key element in the world's climate. Some of the secrets of the earth's past are locked beneath its icecap. It has a fascinating physical environment and a unique and fragile ecosystem. It is a frontier of scientific research and technological development.

Antarctica is unique and its history is an important and dramatic story of discovery and exploration. This story is sometimes inspiring, sometimes tragic, but it has much to teach us about how people react under extreme conditions and how they can live with each other and their environment.

The Pacific Circle Consortium believes that educational materials are most valuable when developed jointly, reflecting interests, issues and concerns that extend beyond national boundaries. For New Zealand and Australia, Antarctica is the Near South. Both New Zealand and Australia, along with other Pacific Circle members, Japan and the United States, are original signatories to the Antarctic Treaty. In that treaty, the nations recognised that it was in the interest of all the human race that Antarctica should forever be used only for peaceful purposes, and that freedom and international co-operation in scientific work in Antarctica would contribute to science and the progress of humanity.

The conservation and protection of the relatively pristine Antarctic environment is vital to our two nations. The wise international use and management of Antarctic resources will present many challenges that we, with the rest of the world community, will have to face and overcome. We trust that students and teachers will gain greater understanding, as well as enjoyment, as a result of studying this material.

For our own sakes and for the sake of the future of the whole world, the children of the Pacific must understand Antarctica, its problems and its importance.

Warren Brewer
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Commonwealth Schools Commission
Canberra

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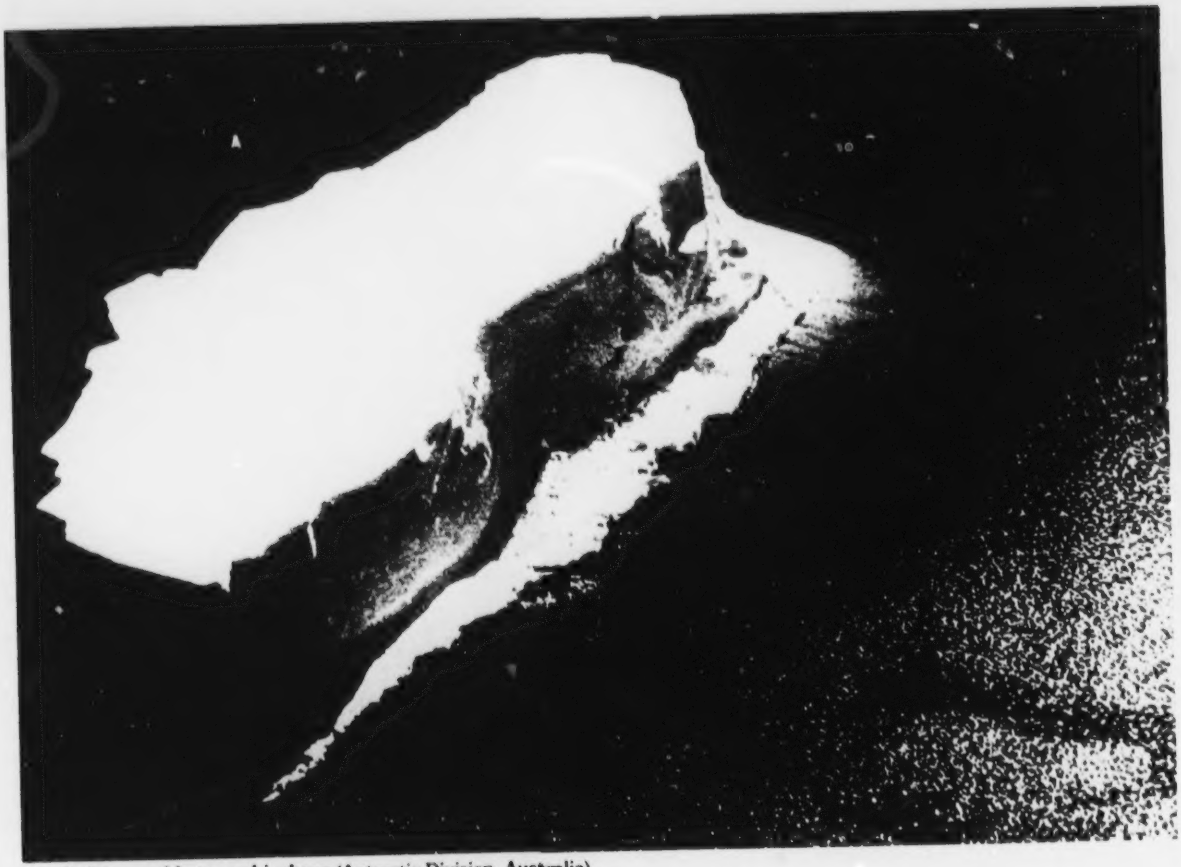
New Zealand Department of Education



A tabular or table-topped iceberg (Antarctic Division, Australia).

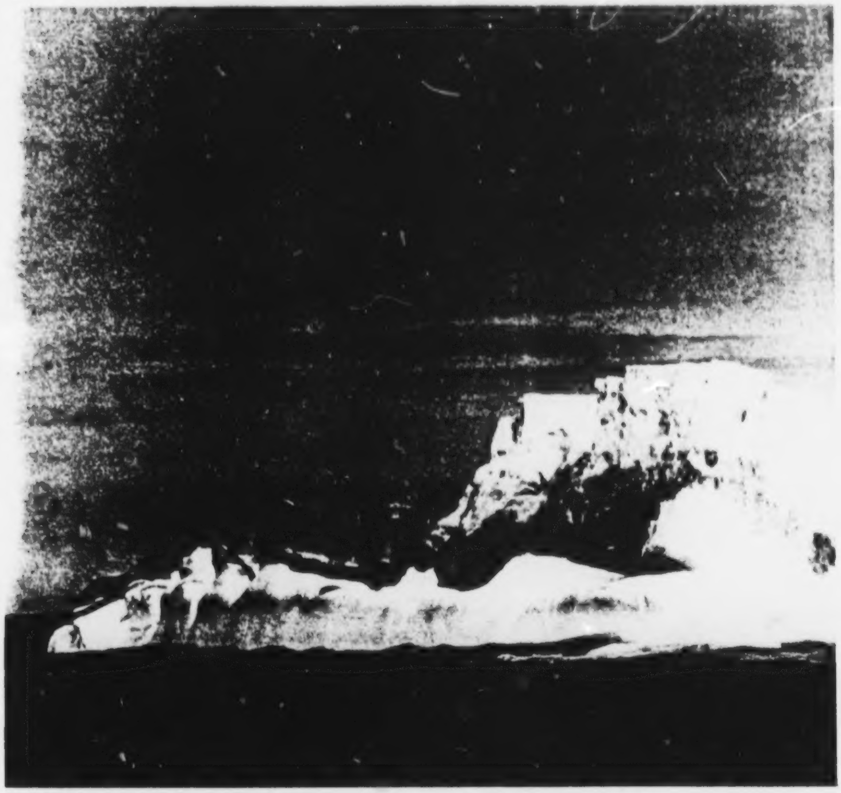
Introduction

Antarctica was the last continent to be discovered. Humans saw it for the first time two hundred years ago, when they managed to fight their way through the stormy seas, thick fogs and swirling ice fields which surround Antarctica.

What did they find? A white desert, bitterly cold, windswept, and covered with ice a thousand metres thick. Despite the difficulties, the explorers pressed on.

They had to cope with frostbite, snowblindness, sastrugi, crevasses, blizzards and scurvy. Exploration often turned into a desperate battle just to stay alive.

Since 1950, nations of the world have co-operated to explore Antarctica in an organised way. They have approached the subject cautiously, because they are aware that this continent is one of the last great areas of wilderness in the world.



Old iceberg, eroded and ready to crumble (Antarctic Division, Australia).

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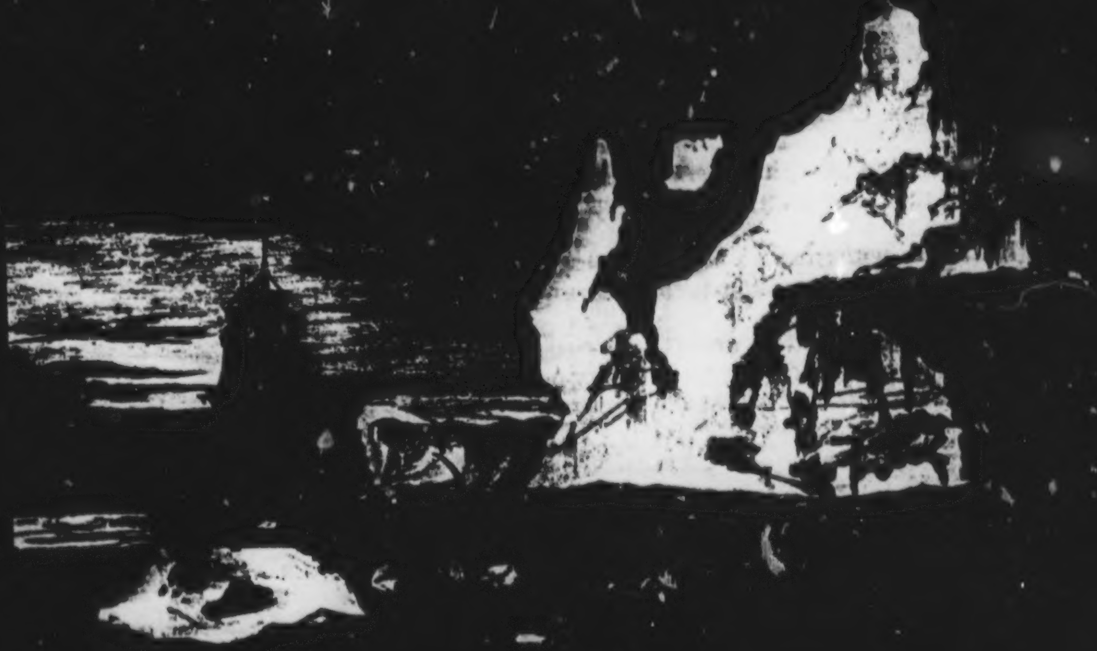

The Ice Islands — icebergs encountered by Cook on 9 January 1773
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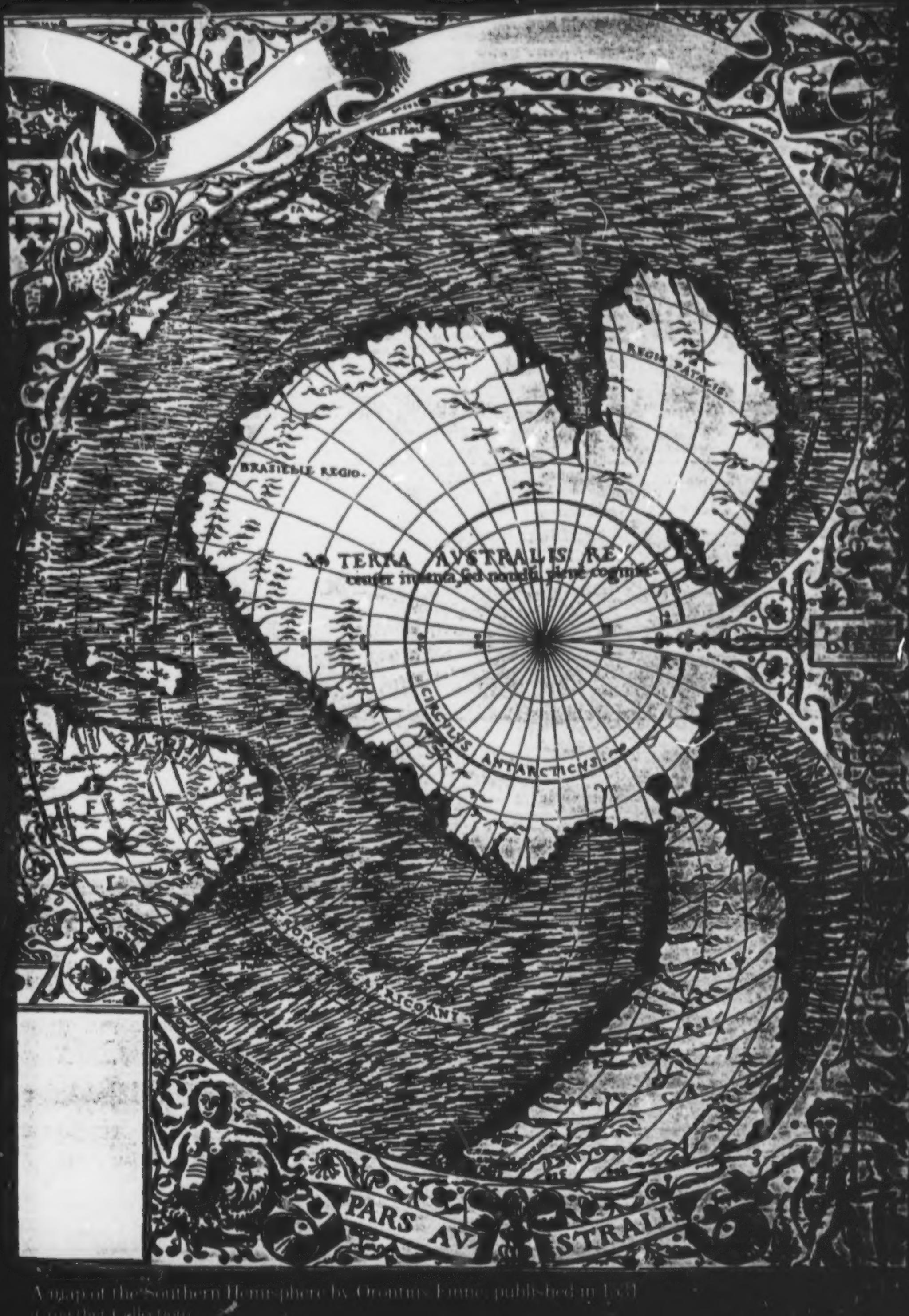
Part 1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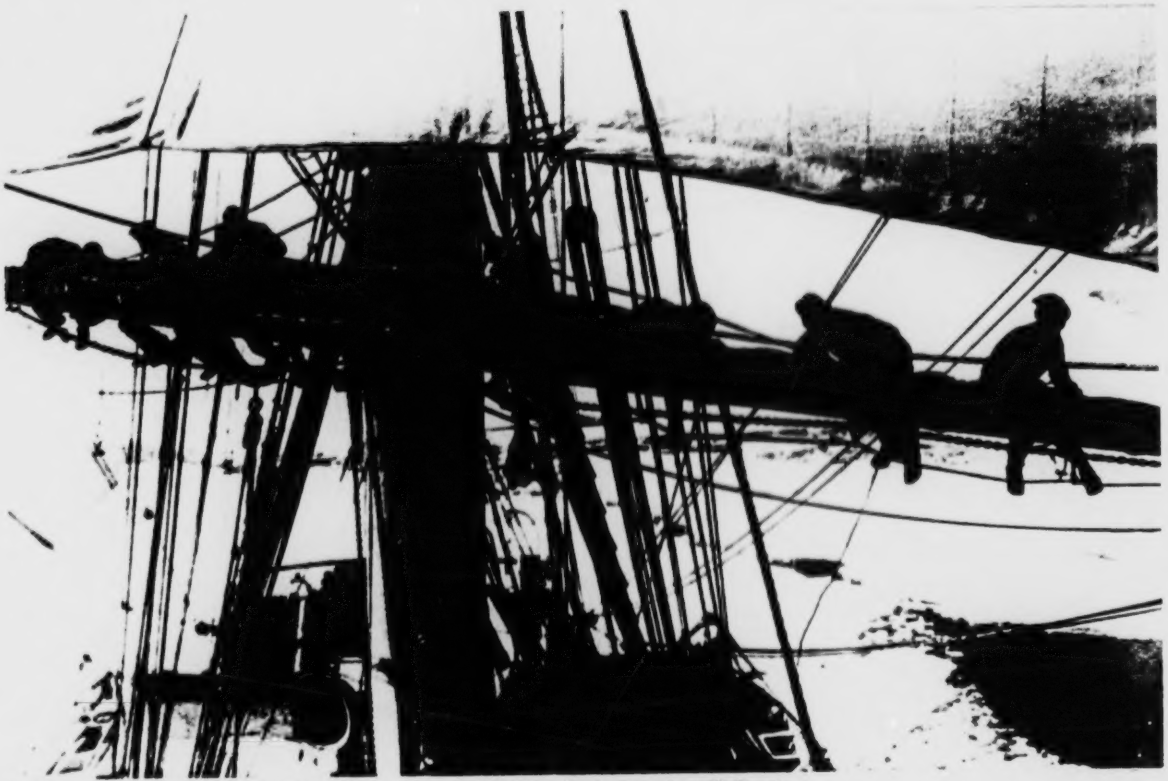
recenter inventa sed nondum plene cognita
REGIO PATALIS
CIRCULUS ANTARCTICUS
TROPICUS CAPRICORNI
PARS AVSTRALIS

A map of the Southern Hemisphere by Orontius Finne, published in 1531
(Crowther Collection)



Furling a sail aboard Scott's *Terra Nova* (Antarctic Division, Australia - photo H. Ponting).

Chapter 1

The search begins

The Great South Land

Two and a half thousand years ago, the Greeks had realised that the world is a globe. Yet at that time they only really knew the lands around the Mediterranean Sea and the Red Sea, and a little about Africa and Asia. They had calculated that these huge areas of land in the northern hemisphere had to be balanced by equally large areas of land on the other side of the globe in the southern hemisphere.

The ancient philosophers were right. The world was round, not flat; and there was a great land mass in the south. But it took two thousand years to prove these ideas, because there was only one way to do so — to sail into the unknown. Until sailors had found something definite, the mystery land of the philosophers was called *Terra Australis Incognita* — the Unknown Land of the South.

By the year 1500 the sailors of Europe were pushing out from their homelands into the great unknown. They were terrified of sailing over the edge of the world, or of being eaten by giant sea monsters. They also knew the dangers of scurvy, a disease caused by lack of fresh food, and that their fragile ships might sink.

They sailed around the bottom of Africa. Then they crossed the Atlantic to the Americas. Magellan proved the world was a globe by sailing around it. Explorers were now able to probe the mysteries of the southern hemisphere.

They found land in the south and took news of their discoveries back to Europe. To the map makers, this proved that the Great South Land existed. They marked all the new discoveries on their maps, joining them up in one huge coastline. The land was renamed *Terra Australis Nunc Bene Cognita* — the South Land Now Well Known. No one knew who lived there or how big it was. They hoped it might have valuable new crops, like the spices of Asia, or minerals, like the gold and silver of South America.

European governments and companies sent ships south to find out. The French explorers, Jean-Baptiste Bouvet de Lozier in 1739, Marion Du Fresne in January 1772 and Yves Joseph de Kerguelen-Tremarec in February 1772, all found new islands. Lozier and Kerguelen thought they had found tips of the southern continent. It was James Cook who proved that, if the great land-mass did exist, it was far to the south, hidden in the pack-ice.

Cook's voyages

Cook had just returned from a very successful voyage across the Pacific Ocean, making the first accurate charts of New Zealand and the east coast of Australia. He was chosen by the British Admiralty to clear up the mystery. His new job was to discover and take possession of the south land in the name of King George III.

Cook made his preparations carefully. He decided to take two ships rather than one, after the trouble he had had on his last voyage when the *Endeavour* grounded on the Great Barrier Reef. The ships had to carry all the stores and equipment, but they could not sit too deeply in the water, because Cook might have to beach them for repairs. He chose two low, roomy ships that had been used for carrying coal.

The flagship was called the *Resolution*. It was a three-masted vessel, a little over thirty-three metres long and ten metres wide, and could

James Cook in 1776 (Crowther Collection).

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carry four hundred and seventy tonnes. The hull had a double layer of wood, rather than wood covered with sheets of copper. Copper might have been rubbed off by ice floes. The other ship, the *Adventure* was much the same but one hundred and thirty tonnes smaller.

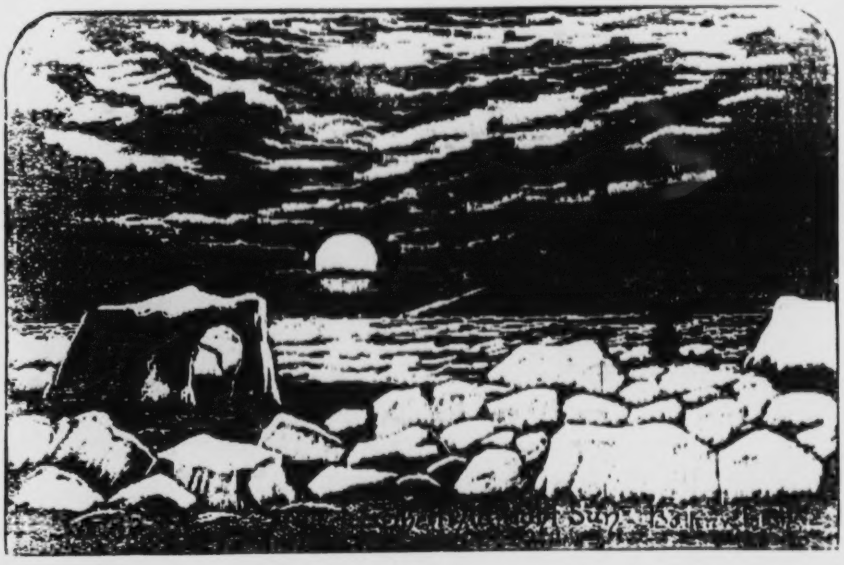
The ships were loaded with food and supplies. There were the usual items like 27,027 kilograms of biscuits, 7637 pieces of salt beef, 14,214 pieces of salt pork, 863 kilograms of suet, 19 casks of beer and 6,361 litres of spirits.

There was also an unusually large quantity of vegetables. These were eaten to prevent scurvy, a common ship's disease. It caused sailors' gums to blacken and swell and their teeth to fall out. Their legs became stiff and swollen, with dark blotches of colour. On long sea voyages, many sailors died of scurvy.

The usual diet on board ship had no fruit or vegetables. Scurvy was caused by lack of vitamin C, and Cook ordered his men to eat vegetables to make up this deficiency. He also made his men wash every day and keep their quarters clean and aired. Clean conditions and good food meant that not one of Cook's men died of scurvy on this three-year trip.

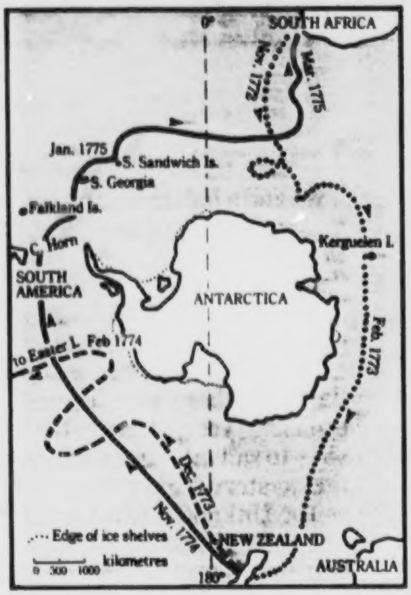
Cook set off in July 1772. He spent three years in the southern hemisphere, and sailed completely around the world in the Southern Ocean. Each summer he sailed as far south as he could, trying to make his way through the ice to reach the Great South Land. In the winters, he sailed north to New Zealand and islands in the Pacific to rest his crews and repair the ships.

Sailing conditions were dreadful. Storms rage west to east across the Southern Ocean with no land to break their force. The small wooden ships met waves fifteen metres high. In all months of the year they risked gales blowing with tremendous force, up to one hundred kilometres an hour. The average year-round windspeed is fifty kilometres an hour.



The midnight sun over a remote Antarctic island.

Cook's voyages, 1772-75



The *Resolution's* log for Friday, 24 December 1773 is typical:

> *Wind northerly, a strong gale attended with a thick fog, sleet and snow, which froze to the rigging as it fell and decorated the whole ship with icicles. Our ropes were like wire, our sails like plates of metal and the sheaves froze fast in the blocks ... I have never seen so much ice.*

Alan Villiers, an experienced sailor, explains what the crews of sailing ships had to face:

> *... to set [the sails], reef them and "hand" them it was essential for men to go aloft, often in large numbers. The rigging froze, with snow and sleet coagulated into its fibres. The sails froze into stiffened statues touched to marble. It was as easy to "hand" them as to furl pressed steel. To touch the rigging was to risk frost burn which sears like flame; and to fight the iron-hard sails aloft meant blooded hands, minced fingers and nails torn out by the roots. For this work could not be done in gloves; a sailing-ship sailor must have his "feel" to work.*

Cook made three attempts to break through the ice — from the Indian Ocean in the summer of 1772-73; from the Pacific Ocean in summer of 1773-74; and from the Atlantic Ocean in the summer of 1774-75.

These "ice cruises" were gigantic zig-zags over the southern parts of three great oceans. They were the first voyages to cross the Antarctic Circle, and Cook reached 71° South. He covered nearly 100,000 kilometres in four years. If there had been a southern continent, Cook would have found it. He only found two groups of remote and desolate islands, South Georgia and the South Sandwich Islands. Cook partly solved the mystery surrounding *Terra Australis*, by proving that a land rich in "Brazil wood, elephants and gold" did not exist.

Yet Cook suspected that there had to be something hidden behind the ice that had barred his way.

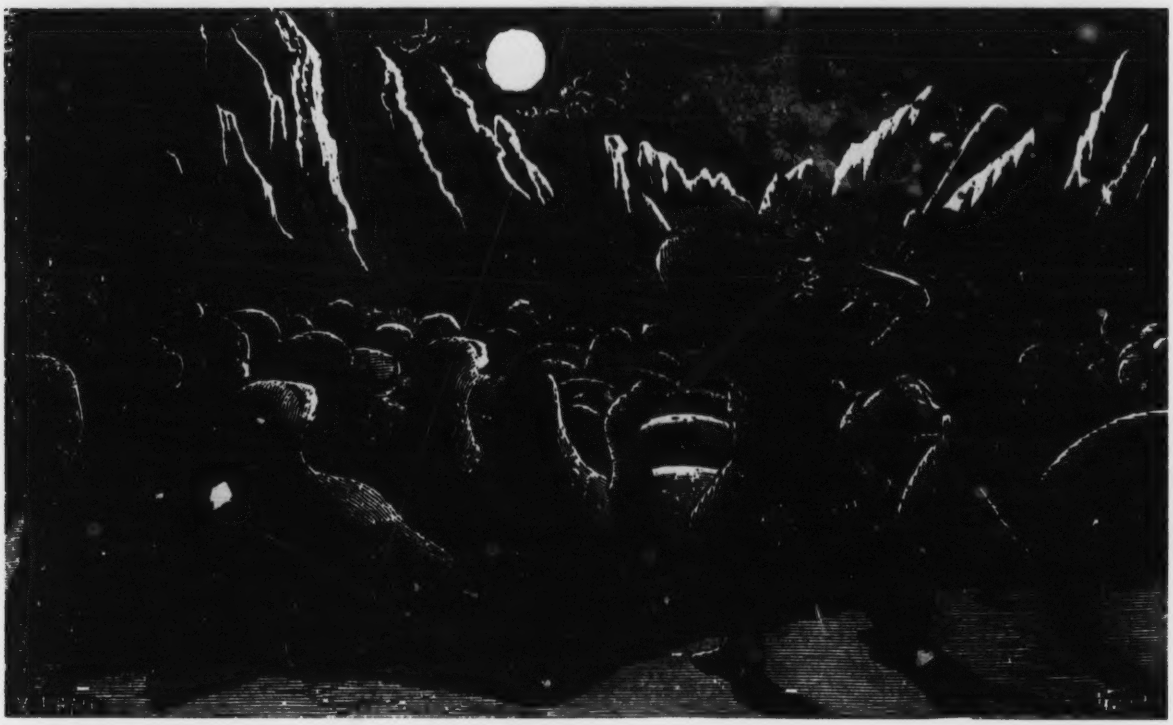
By the time the *Resolution* reached England it had sailed 104,000 kilometres. No vast land had been discovered for King George. But there were observations in Cook's journals which would draw other men to the Southern Ocean. Cook described large herds of whales and seals, and seal pelts and whale oil were fetching high prices in Europe and North America. The captains of the sealing and whaling boats were also tough, adventurous seamen. It was their turn to risk these "unknown and icey seas".

Activities

1. Describe Cook's two ships. Why did he choose this type of vessel?
2. Trace the route of Cook's voyage on a map of the southern hemisphere.
3. What effect did scurvy have on sailors? What did Cook do to prevent it?
4. The log is the official record book of a ship. Make up a log for the *Resolution* describing the events of three days.
5. Explain the meaning of these words:
    - hemisphere
    - ice floe
    - suet
    - sleet
    - sheaves
    - furl
    - pelts
    - hull
6. Work out a day's menu for the sailors.
7. Cook reached 71°10'S. What does this mean?

In the ship's log of 6 February 1775, just as he turned for England, Cook wrote:

> *I firmly believe there is a tract of land near the Pole, which is the source of all the ice spread over this vast Southern Ocean. It is, however, true that the greater part of such a continent (if indeed it exists) must lie within the Polar Circle, where the sea is so pestered with ice that the land is inaccessible. The risk one runs in exploring a coast in these unknown and icey seas is so very great that I doubt if the land which lies to the south will ever be explored. Thick fogs, snow storms, intense cold and every other thing that can render navigation dangerous one has to encounter, and these difficulties are heightened by the inexpressibly horrid aspect of the country, a country doomed by nature to lie buried under everlasting ice and snow.*



The sealers' methods were very simple: they clubbed the animals to death (Crowther Collection).

Chapter 2

Whalers and sealers: bites and nibbles

The sealers

Less than ten years after Cook returned, the first whalers and sealers came down to the islands and seas he had discovered. In summer, seal herds gathered on ice floes and the shoreline. The sealers' methods were very simple: they clubbed the animals to death.

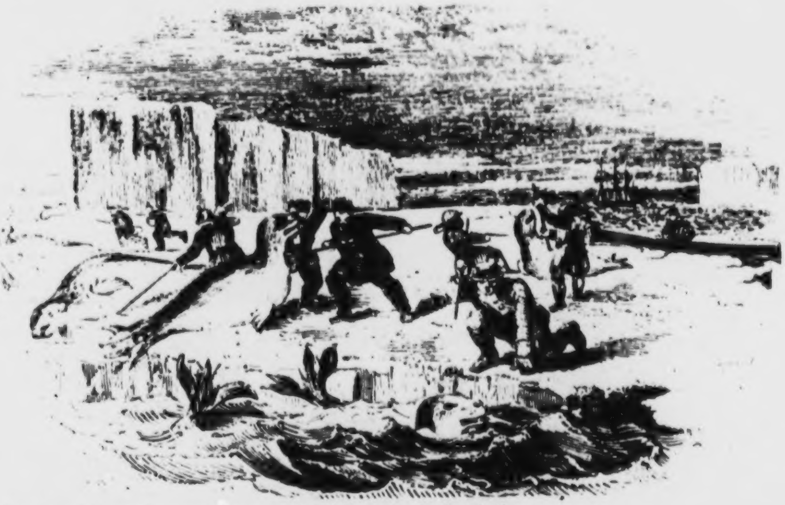
The seals were finished off with a skinning knife. A beach thick with seals before the men landed would be knee-deep in blood, guts and blubber by the time they left.

An expert could kill and skin fifty seals an hour. With pelts selling for five dollars each in New York, big money was involved. If the captain thought a man might tell of a promising new breeding ground he was likely to be marooned, and left to die. Captain Althearn of Nantucket said: "If I got out to a rookery early and found a great show of seals, I would get as many aboard as I could. I would then leave on the rocks all the men I thought would blab, go to the most convenient port and sell my skins."

As the fur seals became harder to find, the sealers turned to the southern elephant seal, a huge animal with a lot of valuable blubber. The elephant seals were herded as close to the water as possible before being killed, to save carrying their carcasses to the heavy trypots at the water's edge. Their blubber was stripped off (like peeling an orange) and hacked into squares. Then it was roughly minced and boiled in the large iron pot.

These methods quickly killed off whole colonies of seals. The sealers moved on, looking for new colonies on new islands. In their search for hunting grounds, they visited unknown islands and coastal areas of Antarctica, but there are few records of their discoveries. The sealers were very secretive as they tried to hide information from each other. Few details were entered in ships' logs.

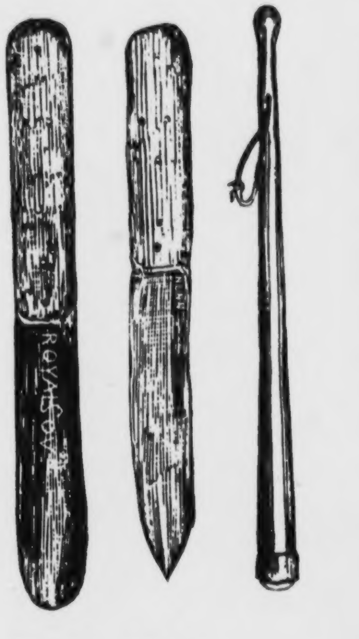
Many sealers and whalers worked out of Sydney and Hobart in the early days of the Australian colonies. Bases were established at Heard, Macquarie and Campbell Islands.



Ross' men seal-hunting on the pack ice (Crowther Collection).

Come all ye brave sailors who're cruising for sparm
Come all ye brave seamen who sail round the Horn —
Our captain has told us, and we hope it proves true,
There's plenty more whales 'long the coast of Peru.

The usual practice was to wait off-shore until a sufficient number of seals had gathered on the beach, and then the ship's crew landed in small boats and cut off their retreat to the sea. The club was a thick wooden stave about four feet long and its end was studded with nails. One quick blow on the head as the animal reared up was enough to knock it senseless.

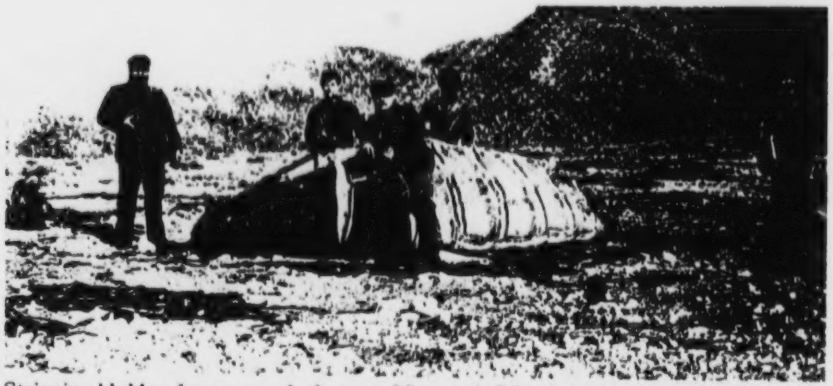


Seal club and knives (Crowther Collection).

The whalers

Whalers were also searching the Southern Ocean, attracted by the reports of Cook's crew. Charles Clerke, one of Cook's officers, had commented on seeing whales "blowing at every point of the compass". They were so common that their smell polluted the air and Clerke thought there were more "whales and seals rowling about these straits" than anywhere else in the world.

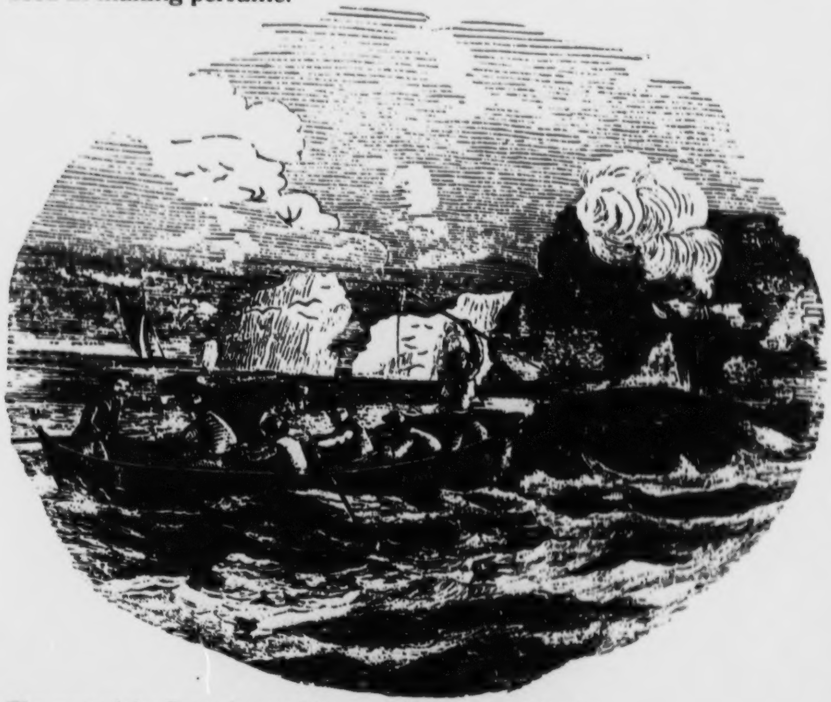
The whalers were also tough men. Southern Ocean whales were bigger and fiercer than those of the northern hemisphere. The whaling crews hunted them from rowing boats, with harpoons, lances and a few hundred metres of rope. When a whale was sighted by the masthead lookout, the mother ship would launch half a dozen of these boats to chase it.



Stripping blubber from a sea-elephant on Macquarie Island (Crowther Collection).

Experienced whalers would recognise the type of whale they were chasing by the shape of its spout.

Some sperm whales contained ambergris, a valuable substance used in making perfume.



The crew of the *Favourite* attacking a whale (Crowther Collection).

Clerke wrote:

Each boat had a harpooner in the prow, and he would sink his shaft with its attached line from half a dozen yards away. Then, when the whale dived, the line would run out, perhaps a couple of hundred fathoms of it, and away the boat would go on a wild career through the waves until the line slackened and the beast surfaced again to breathe; and again the whalemen would strike, this time with lances, and again the whale would sound, and this would go on for an hour or an entire day until at last the quarry was exhausted, and its life's blood gushed out from its blowhole.

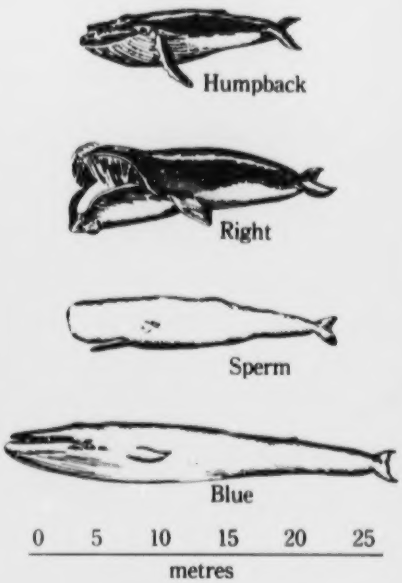
One whaler described how the crew searched for it:

It was eight bells (midnight) when we had cut-in the final fish. The Daisy *rolled gently in the quiet swell ... the officers on the cutting stage punched with their spades as best they could in the dismal light of lanterns and oil-soaked torches. The flickering light showed the hulk of the whale alongside and the flash of bloody wavelets ... On deck a light of burning blubber scrap, and the fiery chimneys of the tryworks in full blast, cast enough illumination to reveal the great blankets of blubber and the greasy, toiling figures ...*

The Old Man (captain) joined his officers on the cutting stage, then, with methodical movements, he and the three mates thrust freshly sharpened cutting spades deeply into the guts of the whale, twisted them, cautiously withdrew them, smelled the bright steel blades ... back and forth until the vitals had been intimately explored. But nary a whiff of the longed-for odour of ambergris was forthcoming.

Life as a sealer or whaler was hard and dangerous. Many who set out for southern waters never returned to tell the tale. Many others refused to say anything, and guarded their secrets closely. But others returning from a long sea voyage in ships laden with seal pelts and blubber oil could not help boasting. Stories of fortunes made in the Southern Ocean were heard in ports throughout the world. Rumours spread of mysterious mountains rising out of the sea, far to the south of whaling and sealing grounds. These rumours interested governments, scientists and explorers.

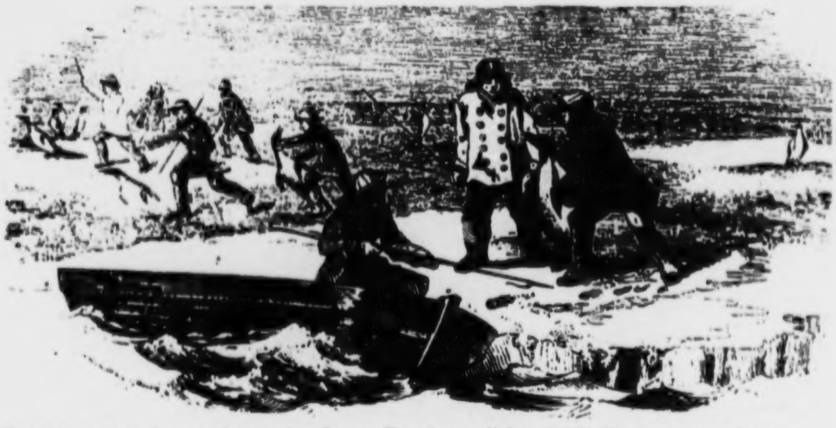
Was there a land behind the ice that stopped Cook? New expeditions were sent to look. Their job was to penetrate the wall of ice and the mysteries of *Terra Australis.*



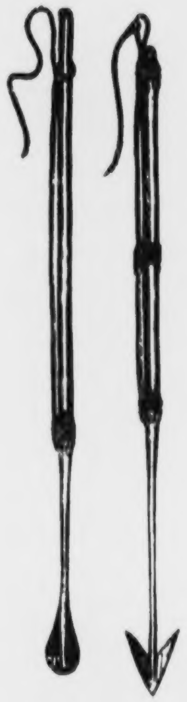
MAIN TYPES OF WHALE

Activities

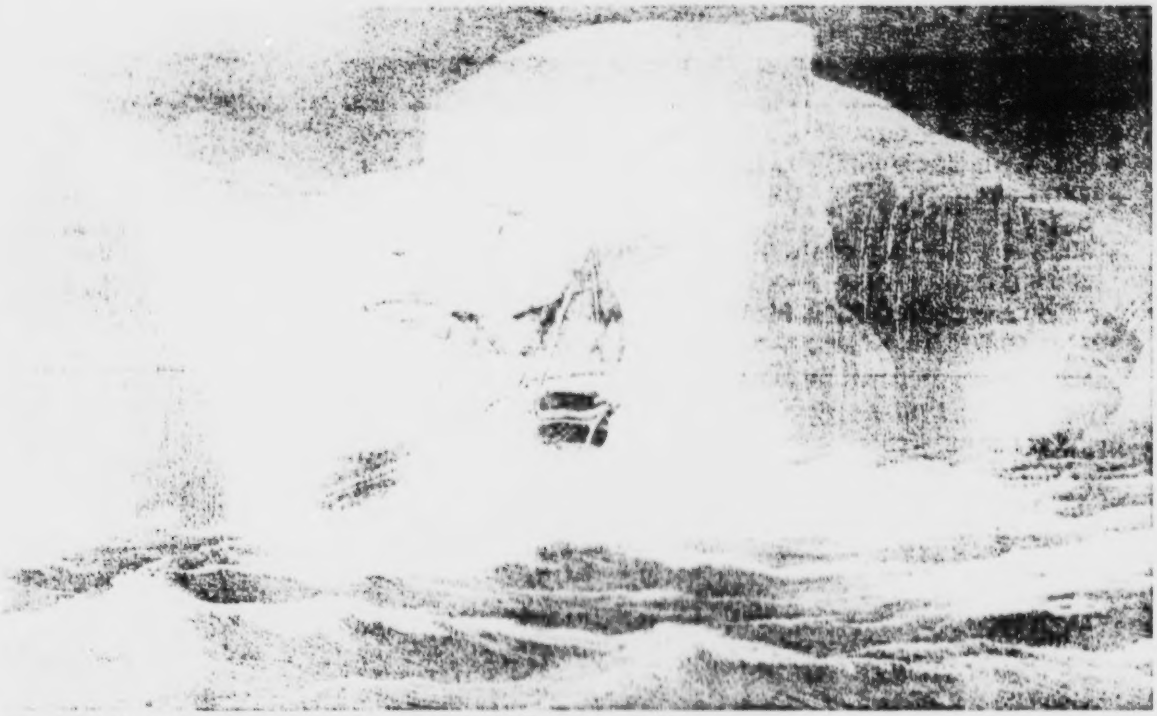
1. Research: Choose four of the topics below to look up in reference books. Write down what you found out, including diagrams and illustrations.
   trypot
   blubber
   ambergris
   baleen
   harpoons
   types of whales
2. Whalers and sealers visited the islands around Antarctica. Use an atlas to make a list of these islands.
3. Would you have enjoyed the life of a whaler or a sealer? Why?
4. What effect did the activities of whalers and sealers have on the discovery of Antarctica?
5. The *Daisy* has just returned to port "laden with seal pelts and blubber oil". Re-tell the story the sailors told in the pubs that night.
6. How many centimetres are there in:
   an inch
   a foot
   a yard
   a fathom?



Catching penguins on the sea ice. James Ross' expedition, 1839-43 (Crowther Collection).



A whaler's weapons: the harpoon (A) and the lance (B) (Crowther Collection).



Furious winds drive *Erebus* between giant icebergs, 1842 (Crowther Collection).

Chapter 3

The new continent: first sight

Dangers of the Antarctic

The first ships to sail into Antarctic waters were frail craft, much smaller and lighter than today's ferries. They were confronted by hurricane winds, enormous seas, fog, snow and ice in their search for wealth, scientific information, or places for colonies.

After their first contact with these hazards, the new wave of Antarctic explorers began to choose specially strengthened ships. They had to be built strongly so that contact with the ice would not damage them easily. They had to be able to crash through the thin sheet ice which covered the sea or to scrape along the side of a huge iceberg, or withstand the pressure of the moving ice pack.

The sea is the greatest obstacle to ships trying to reach Antarctica. In winter time the sea freezes over for hundreds of kilometres from the land's shoreline. When this sea ice breaks up in the warmer months, pack ice is formed. It is moved by winds and currents. Large fragments of ice ride up over each other and form jagged floes. Sometimes this moving ice freezes up again. In the days before icebreakers, ships faced enormous danger when trying to penetrate sea ice and pack ice.

Icebergs might have flat tops or jagged tops. The flat-topped ones are called "tabular icebergs". They may be up to forty kilometres long and four hundred metres thick. Tabular icebergs have broken off the large ice shelves that are found in many of the gulfs and bays of the Antarctic coast. "Glacial" icebergs have jagged tops. They have broken off the tongues of ice where glaciers project into the sea.

Captains of ships bound for the Antarctic began to experiment with ways to strengthen them against collisions with ice. Captain Ross took the *Erebus* and *Terror* to Antarctica with completely replaced decks. First, a new layer of decking was put down, than a special waterproof cloth, with another layer of decking on top. The hull was protected with two layers of copper sheeting.

Bellingshausen put copper around the hull of his ship *Vostok*. The inside of the hull was braced by a network of iron scaffolding. He shortened the masts and remade the rudder of oak.

Other captains chose greenheart as a cover over the hull. This is a flexible, iron-hard tropical timber, just right to cope with the grinding and pounding of ice. Greenheart protected the ship *Antarctic* when it was trapped in the ice in 1895, but on a later voyage it was not so lucky. The sea froze around it, then steadily crushed it to matchwood, leaving the crew marooned on the ice.

Douglas Mawson, the Australian explorer, thought wooden ships were better than steel ones. Wood has more "give" than steel and absorbs some of the shock of hitting ice. A steel boat of that time ripped open like a tin can on colliding with ice.

Despite all the strengthening, with massive new timbers supporting thickly planked hulls, ships were still damaged.

To get to the Antarctic, ships had to pick their way carefully through the pack ice surrounding it. This ice, about two metres thick, is swept slowly around the Antarctic by the wind, tides and currents. It can trap ships or icebergs by freezing them in, but it is even more dangerous

Thaddeus von Bellingshausen, Captain of the *Vostok*, 1819-21 (Crowther Collection).

Ice was a constant threat and Captain Bull of the *Antarctic* wrote:

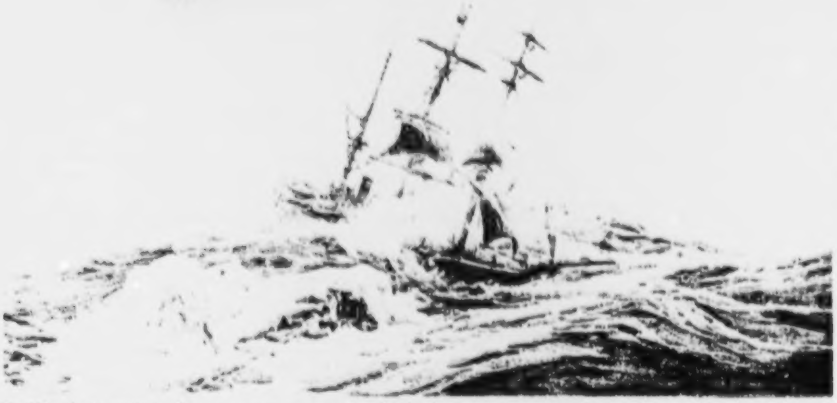
> *Continual bumping against heavier pack ice, and violent shocks to the vessel is commonplace in Antarctic waters. There is a series of collisions of a force ... which (finds) the hull trembling from stem to stern and the masts bending ... while the ship's complement are flung bodily forward.*

when it starts to loosen and move around. Then the moving icefield can crush or hole ships caught in its path.

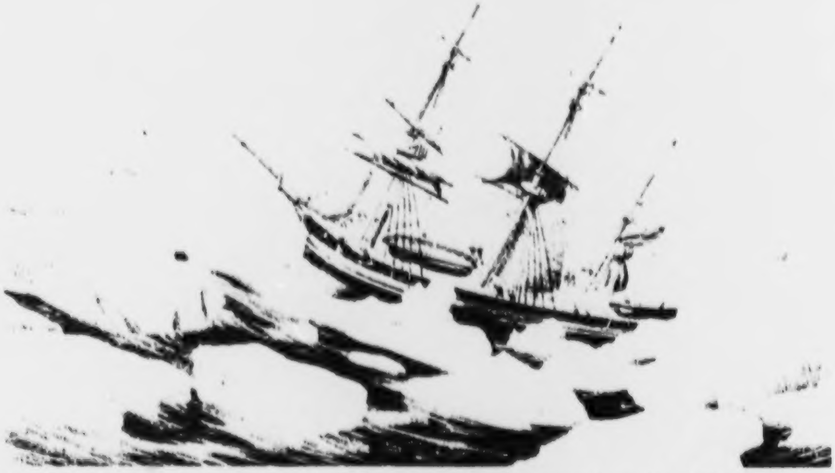
In summer, stretches of open water called "leads" open up through the icefields. Ships of a later era could push through thinner ice up to a metre thick, especially if they had a steeply sloping bow. When such ships hit the ice, they rode up on to the ice floe.

Sometimes the ships were trapped when the ice closed in and there was no opening to water. Then they might spend months caught fast in a vast icefield, until the next summer.

The ice varies from a few centimetres to several metres thick. The field itself is never still. It is moved this way and that by the winds, tides and currents. Trapped ships are carried along with the field. The *Antarctic* was caught in 1903.



Bull's *Antarctic* in heavy seas amongst the icebergs (Crowther Collection).



A gale in the pack ice, as painted by John Edward Davis, second master of the *Terror* (National Library).

Then with a shuddering bump the bow rises on a floe — up and up we seem to go — when suddenly she subsides, and cracks go shooting across the ice. Other times she hangs there with her bows up, and we have to go astern to try once more. Over and over the process is repeated, while the ship jars, twists and shudders until one feels she will fall apart.

Crew member Carl Skottsberg wrote:

Imprisoned again! We are being carried helplessly this way and that in the ice, now stern first, now broadside on; sometimes squeezing between the enormous flat-topped bergs, sometimes drifting over hidden reefs. It is miraculous that the ship has not been more seriously damaged. Larsen orders us to sleep with our clothes on ...

The ice is most dangerous in autumn and spring when it is not frozen solid. Moving ice floes can slowly crush a ship to death. In 1915 Ernest Shackleton's ship was crushed after being caught in the ice for nine months. He described his last day on the *Endurance*:

> *It was a sickening sensation to feel the deck breaking up under one's feet, the great beams bending then snapping with a noise like gunfire. I looked down the skylight and saw the engines dropping sideways as the stays and bedplates gave way. I cannot describe the impression of relentless destruction as I looked about me. The floes, with the force of millions of tons of moving ice behind them, were simply annihilating the ship.*

Endurance in pack ice, January 1915 (Mitchell Library - photo Frank Hurley).

Bransfield and Smith's route, 1819-20

H AFRICA
ANTARCTICA
RALIA

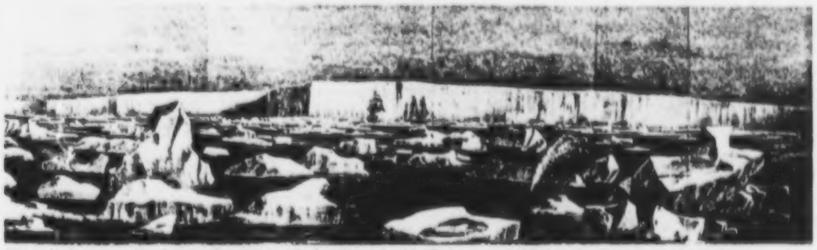
Shackleton tried to free the *Endurance* by cutting and chipping a path through the ice with saws and ice-chisels. It didn't work. Other explorers tried to crack the ice with explosives. The *Scotia*'s crew used gunpowder to try to blast a path. The captain of the *Belgica* ordered his men to blow up the ice with tonite, an explosive more powerful than dynamite. They just blew shallow holes in the ice.

Storms were a problem, too. Ships used large icebergs as windbreaks. They would sail in behind them to get out of the high winds and heavy seas, but the massive mountains of ice held other dangers. Sometimes the ships accidentally rammed them. In a storm their captains were forced to make hard, fast decisions between dangerous courses.

Winds reaching hurricane force could rip a ship's sails to shreds. The topsails, staysails and mizzensails of the *Vostok* split and were blown away. Bellingshausen, her captain, commented later that "the seas were an extraordinary height, and appeared to mingle with the air. In order to try and keep our head into wind, I ordered the men to hoist hammocks into the shrouds".

At times ships became so encrusted with ice they were barely able to keep afloat. Bellingshausen reported a snowfall so heavy that his crew "were hard-pressed to shovel it away". The ships had to be turned sharply into the wind every so often to shake snow off the sails.

Captain Cook's *Resolution* nearly capsized in heavy seas when the vessel rolled 43° from the vertical. Other captains have been unable to steer their vessels when the rudders froze. In thick fog, Bellingshausen ordered his lookouts to hang over the side of *Vostok* on rope ladders. The fog was thinner at sea level, and they could see icebergs and hear waves more easily.



Ross' ships sail along the face of the ice shelf, February 1841 (Crowther Collection).

The first sighting

No one is quite sure who first saw the Antarctic continent. It might have been Thaddeus von Bellingshausen on 27 January 1820. The Russian Tsar sent him to search for new harbours and fisheries. He was also sent to find as much scientific information as he could about the ocean, the weather and the land. Like Cook, he sailed right round the Antarctic, but much closer to the coastline.

In his ship's log, he wrote about seeing "a solid stretch of ice, running from east to west" and "ice-covered mountains rising to a great height".

Bellingshausen was looking for land, not a coastline of ice. He was hoping to meet the people of this new land, and his orders were that "the natives are to be treated with kindness and humanity. You must avoid giving offence or displeasure; on the contrary, you must make every effort to win their friendship by gentleness. You shall never resort to severe measures".

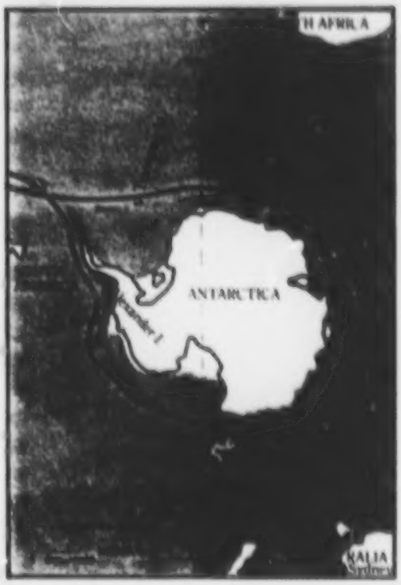
His "solid stretch of ice" and "ice-covered mountains" may well have been a part of the coastline of Antarctica that he had mistaken for a giant icefield. Heavy snowfalls, thick fogs and low cloud made visibility bad. The seas were so rough that it would have been impossible to land on these ice cliffs.

The British naval officer Edward Bransfield, with his pilot, the merchant captain William Smith, certainly saw the tip of Antarctica that stretched out towards South America. They were sent by the British Government to chart any new coastline, "to report on the natural resources of the land for supporting a colony, and to observe the character, habits and customs of the inhabitants, to whom you will display every friendly disposition". On 30 January 1820, Bransfield sighted the mountains of what he called Trinity Land. He did not try to land there, probably because of the fog, the seas and the ice.

Possibly some daring captain saw Antarctica before either Bransfield or Bellingshausen. Some authorities claim that the American sealer Nathaniel Palmer was first — and his log shows that he certainly sighted the Antarctic Peninsula in November 1820. But most sealer captains kept their discoveries secret to discourage competition.

Yet the mystery of the southern continent was slowly being penetrated. Human curiosity was strong enough to inspire explorers to conquer the hurricane winds, the seas, the fogs and the ice. The first expeditions on the land itself would start around the turn of the century.

Bellingshausen's route, 1819-21

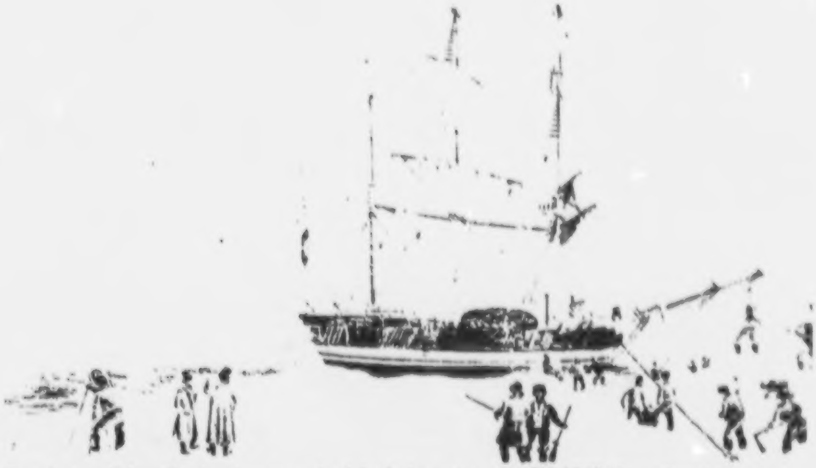


Activities

1. Explain the meaning of each of these words:

   hull deck
   rudder stern
   bow shrouds
   mast sails

   Now draw a diagram of a ship, showing each one of those features.
2. What is the difference between pack ice and icebergs? Why was the ice dangerous?
3. Draw a labelled diagram to show how the ships were strengthened.
4. Read the orders that were given to Bellingshausen and Bransfield. What sort of place did the Tsar and the British Government hope to find?
5. Make a list of all the special problems ships faced in Antarctic waters. Put them in order, with the most serious problem first.



Ross' expedition digging ice to replenish their water supply, 1842 (Crowther Collection).

Tea at four o'clock aboard the *Belgica*: Arctowski (left) and astronomer Georges Lecointe (Tasmanian Collection, State Library of Tasmania).

Chapter 4

Wintering: The first party

A white desert?

No one knows who first set foot on the Antarctic continent. It may have been John Davis who landed by chance in 1821 while looking for new colonies of seals. Some of Davis's party went ashore at Hughes Bay near Trinity Island.

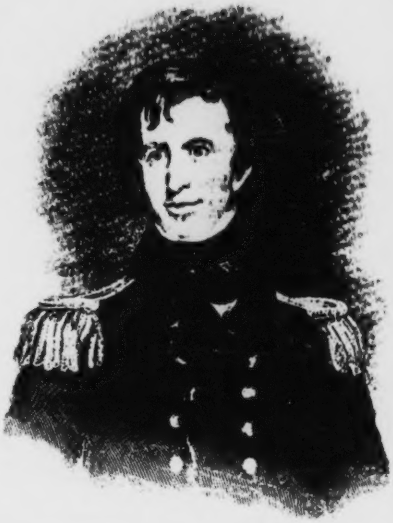
In the 1830s, three major expeditions made landings. Dumont D'Urville sailed from France in 1837, Charles Wilkes from America in 1838 and James Ross from England in 1839. All three penetrated the pack ice and spent some days sailing in clear seas alongside the ice cliffs of the continent. All landed on offshore islands and raised their national flags.

Each expedition and each landing helped build up a new picture of the real Antarctica. The continent was covered by a massive sheet of ice, with only a few rocky outcrops poking through. It was cold - the average temperature on the coast was minus 17°C - and the wind never stopped blowing, which made it feel even colder (see Appendix C). In summer the days were very long. In winter there was no daylight. Some snow fell, but not much, and rain was unusual.

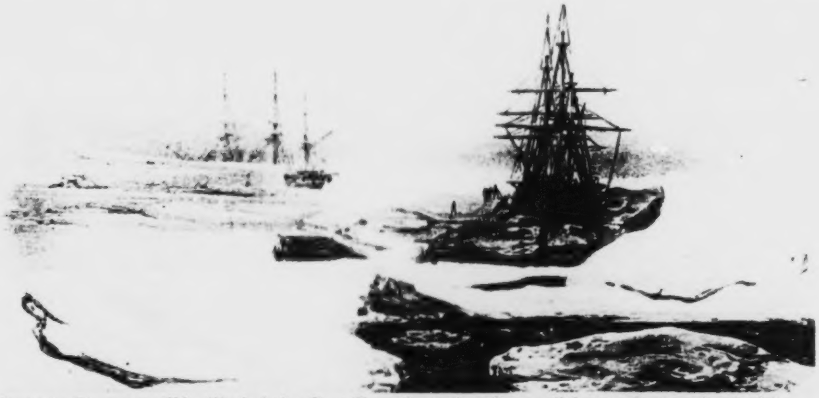
When these reports came back, people lost interest in Antarctica. What value could there be in a freezing cold, ice-covered country? It could not be used as a place to settle people or grow crops. If any minerals existed there, it would be too difficult to mine them. Antarctica, people thought, was a useless white desert. And so they left it alone.

For the next fifty years, the only activity in the remote south was in the oceans. Whalers worked the stormy seas chasing herds of whales. It was a whaling party which made the first confirmed landing on the Antarctic continent. The Norwegian whaler *Antarctic,* managed by Henryk Bull, put a party of men ashore at Cape Adare on 24 January 1895. But even then they couldn't agree who had stepped ashore first - whether it was the Captain, Lars Kristensen, or Carstens Borchgrevink (later to lead his own expedition) or a seventeen year-old New Zealander from Stewart Island, Alexander von Tunzelman.

Even so, little was known about the southern continent, and its mysteries still intrigued explorers and scientists. In 1895 the International Geographical Congress decided to encourage more investigation. These scientists urged the countries of the world to send teams to the Antarctic to find out exactly what was there and how people could learn about its resources.



Lt Charles Wilkes of the *Vincennes* headed the first US government expedition to Antarctica in 1838-42 (Crowther Collection).



Captain Dumont d'Urville led the first French national expedition to Antarctica in his flagship *Astrolabe*, 1837-40. Here his crew struggle to free the ship from the pack ice.

de Gerlache (1897 - 99)

In August 1897 a Belgian naval lieutenant, Adrien de Gerlache, set off with his international crew of nineteen in the small whaler *Belgica*. Five of them were scientists - a meteorologist, a geologist, a naturalist, a magnetician and a doctor. Roald Amundsen, who would be a famous Antarctic explorer, was first mate. They reached Antarctica in January 1898 and cruised along the coast. The scientists landed on offshore islands two or three times a day to look around and collect specimens. The geologist turned over a rock while collecting samples and discovered "mysterious crawling things". These turned out to be mites and wingless flies, the only animals - except for emperor penguins - that live the year round in Antarctica.

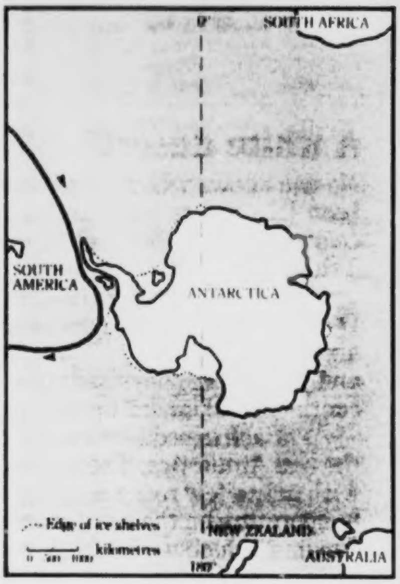
The men climbed a mountain to get a good look at the coastline. It took them seven days to struggle up the five hundred metre peak. They could hardly stand up against strong winds, and the fog and crevasses made travelling slow and dangerous. Dragging the sledges was very hard work.

These explorers from the *Belgica* were the first to camp and travel in Antarctica. The problems they found - winds, cold and crevasses - have troubled every explorer who followed them.

De Gerlache sailed further along the coast, trying to get as far south as he could. It was towards the end of summer and the ice around the ship was beginning to thicken. Still the *Belgica* ploughed on south. The ice closed in and by early March the ship was firmly trapped. The crew were to remain in the Antarctic ice for more than a year.

At first they were kept busy. As the ship was carried backwards and forwards by the groaning ice, they built shelters and observation posts. The cabins needed warmth and fresh air, and they experimented with different heating systems.

De Gerlache, 1897-99



The *Belgica* in September, caught fast in the ice (Tasmanian Collection, State Library of Tasmania).

Adrien de Gerlache set off with his international crew of nineteen in the small whaler *Belgica* in 1897 (Crowther Collection).

As winter drew closer, the days grew shorter and the sun barely rose in the sky at all. On 17 May it did not rise above the horizon. The long Antarctic winter had begun. For the *Belgica*, it would be sixty-eight days without sun (see Appendix D).

The *Belgica* was a solid ship and it was well stocked with fuel and food. The crew could put up with the cold and damp and the never-ending wind, but the long darkness depressed them. There was no natural light and warmth, no natural pattern to the passing of time. They became tired, lonely and fed-up.

Two went mad under the strain of living on the trapped ship.

Cutting a canal to free the *Belgica* after the first Antarctic wintering (Tasmanian Collection, State Library of Tasmania).

Roald Amundsen at the age of 25 was first mate of the *Belgica* (Tasmanian Collection, State Library of Tasmania).

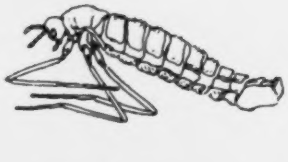
The stress affected some men seriously. Their hearts beat quickly and then slowly, but never normally. The doctor found a remedy for this reaction to lack of sunlight:

The best substitute for the sun is direct rays of heat from an open fire ... I have stripped and placed men whose pulse was almost imperceptible in this sort of heat, and in less than an hour their heart action has returned to normal.

Frederick Cook, ship's doctor of the *Belgica* (Tasmanian Collection, State Library of Tasmania).

The ship's doctor, Frederick Cook, realised the *Belgica* would be trapped for a long time:

We are now doomed to remain, and become the football of an unpromising fate. Henceforth, we are to be kicked, pushed, squeezed and ushered helplessly at the mercy of the pack.

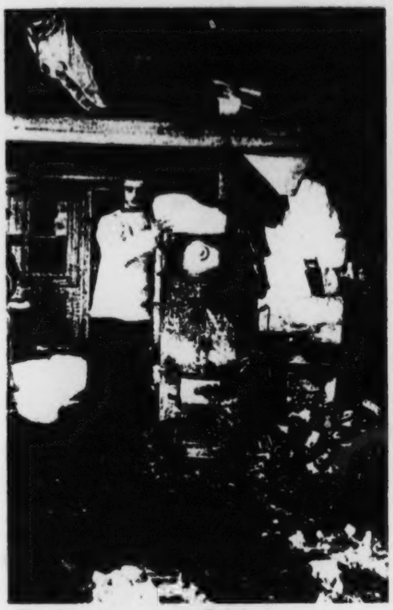


WINGLESS FLY

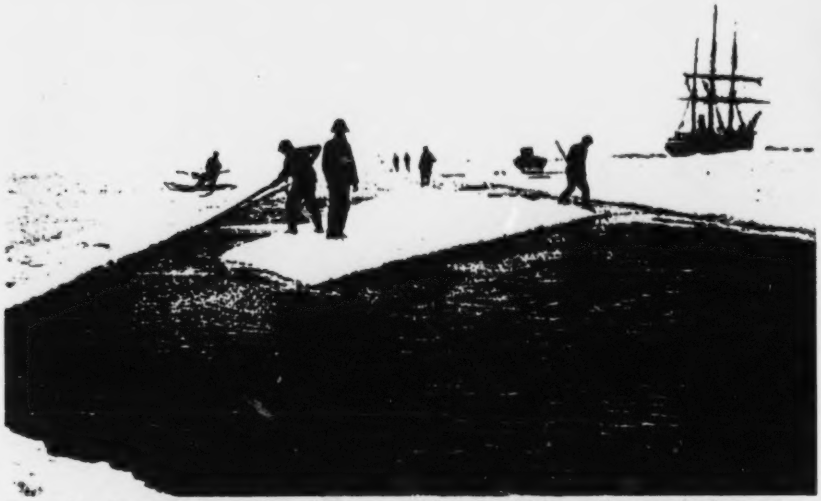
Despite Dr Cook's work, one officer died of heart failure.

As the sun returned next spring, their spirits rose. As soon as the ice melted and broke up, they could escape. But the ice did not melt. The ship remained trapped just as fast as ever. In desperation the crew tried to blow the ice apart with explosives, but they only made great shallow holes. In the end they dug and sawed their way clear. They scraped off the top sixty centimetres of softer ice, and cut through the remaining metre with saws. After several days' hard work, a two-kilometre canal stretched through to the sea, and the *Belgica* steamed out.

The crew could now return to all that they missed most during their ordeal - fresh food, women, news from home and the sun. But they had proved something important: people could survive the long Antarctic winter. This was to change the method of future exploration.



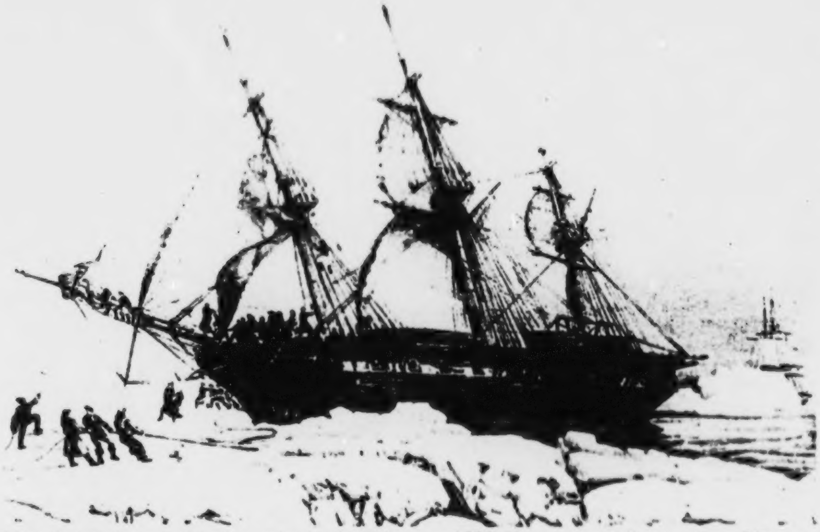
Fresh water on the *Belgica* was supplied by the snow melter. It could use seal blubber as fuel (Tasmanian Collection, State Library of Tasmania).



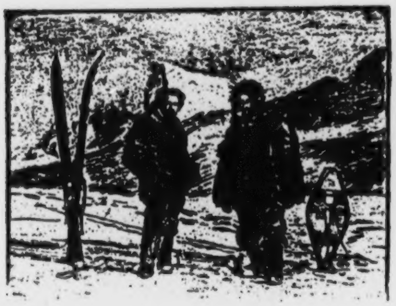
Removing the upper layer of ice. After several days hard labour, the crew had cut a two-kilometre canal, and *Belgica* steamed out in February 1899 (Tasmanian Collection, State Library of Tasmania).

Activities

1. Using the diagrams of the earth's movement around the sun in Appendix D, explain the seasons.
2. What did the five scientists on board the *Belgica* study?
3. You are a crew member on board the *Belgica* and it is the middle of the sunless winter. Make a list of the ten things you miss most.
4. Write the story of how the *Belgica* got free of the ice as though you were de Gerlache.
5. Why did de Gerlache go to Antarctica? What did he find?

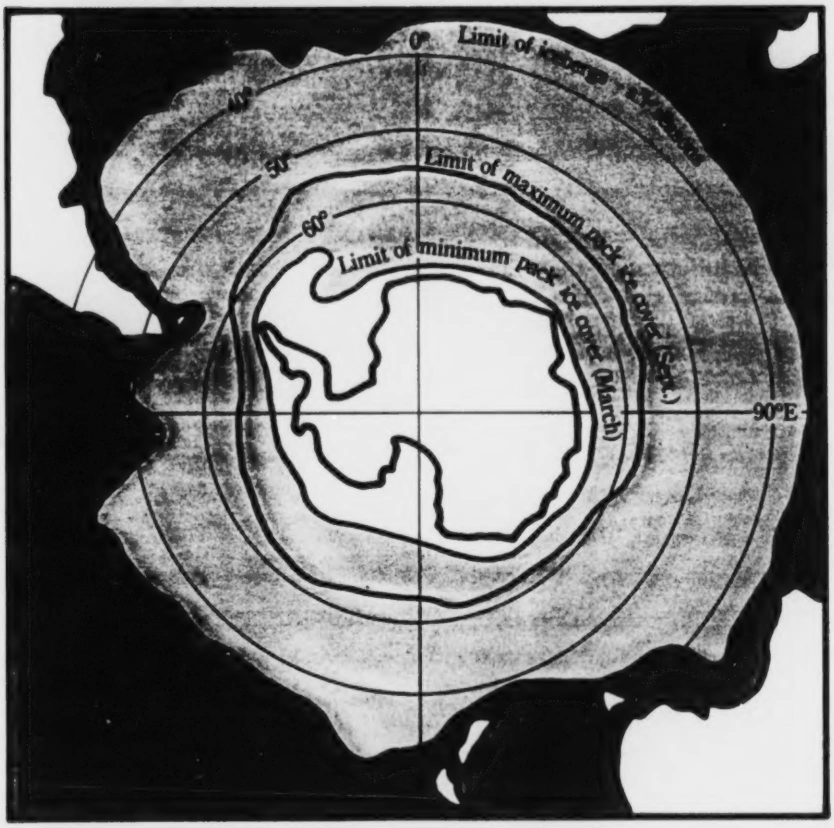


The *Astrolabe* and *Zelee* beset by ice in February 1838 (Tasmanian Collection, State Library of Tasmania).



Polish-born geologist Henryk Arctowski with fellow crew member Amundsen
(Tasmanian Collection, State Library of Tasmania).

How far the ice spreads



0°
Limit of icebergs
40°
50°
60°
Limit of maximum pack ice cover (Sept.)
Limit of minimum pack ice cover (March)
90°E

Huskies and their Lapp handlers at the Hobart quarantine station in 1898 on their way to Antarctica. Borchgrevink's expedition (Tasmanian Archives).

Chapter 5

Exploration on land begins

Huskies on board Borchgrevink's *Southern Cross* (Allport/Crowther Collection).

During the nineteenth century, sailors and scientists had broken through the obstacles which had kept Cook's expedition at a distance from Antarctica. The problems of the seas around the Antarctic were now well known. So were ways to survive them in specially-designed ships. De Gerlache and his crew had shown it was possible to survive the long, cold winter. Now a new group of adventurers could go further. They would explore the land of the vast, icy continent.

The Antarctic could only be reached by sea in summer. But the summers were short. There was not enough time to sail to and from Antarctica *and* explore parts of the land. This is why the *Belgica* expedition was so important. Now that the crew of the *Belgica* had proved that people could live through the sunless Antarctic winter, explorers could plan to sail down there in summer and build a base camp. After spending winter in camp, they had time to explore during the following summer.

Three different expeditions set off soon after the *Belgica* returned. Their leaders were Borchgrevink, Nordenskjold and Scott. Each planned to build a base camp in Antarctica and explore the area around that base. They were equipped with dogs and sledges, special food rations and scientific instruments.

Borchgrevink (1898-1900)

Carstens Borchgrevink was a Norwegian who had worked in Australia. He set foot in Antarctica briefly in 1895. He then organised his own expedition and it was to be the first one to make a planned winter camp on the continent. He sailed in the *Southern Cross*, a five hundred and thirty tonne vessel designed by Colin Archer who later made a name for himself by designing the *Fram* for use in the Arctic.

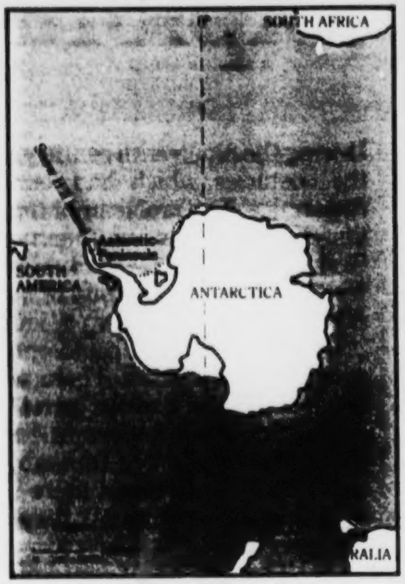
Borchgrevink's expedition left England in August 1898 and spent the winter of 1899 at Cape Adare. Members included Louis Bernacchi, a Tasmanian who had studied magnetism and meteorology, and Nikolai Hanson, a taxidermist. Hanson died during the expedition, the first scientist to die in Antarctica. He was buried on a high promontory overlooking Robertson Bay.

Carstens Borchgrevink led the 1898 British expedition, which was first to winter on the continent (Tasmanian Archives).

Taking magnetic observations on the ice. Borchgrevink's expedition, 1898-1900 (Tasmanian Collection, State Library of Tasmania).

Farthest south: three members of Borchgrevink's expedition, including Tasmanian physicist Louis Bernacchi, stand on the Ross ice shelf at 78° 50′ south, 19 February 1900 (Crowther Collection).

Nordenskjold, 1901-04



Nordenskjold (1901-04)

Otto Nordenskjold sailed from Sweden in 1901 in the *Antarctic*, the whaler of Borchgrevink's first visit. He planned to explore the area of Antarctica south of South America. It was an experimental journey. No one yet knew the best way to travel or the most suitable food to take. No one had tried living in tents for a month in the howling Antarctic winds. Would people be able to survive and work in continuous sub-zero temperatures?

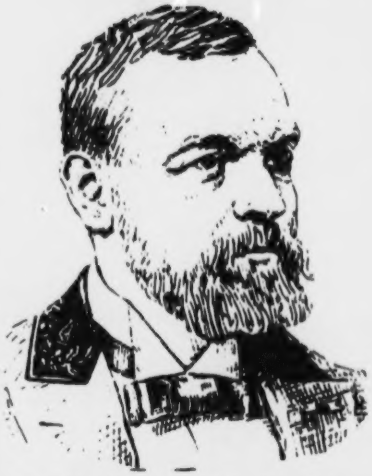
Nordenskjold landed at Snow Hill Island with five companions in February 1902. His first job while the summer lasted was to build a hut. It was very windy and cold that winter, but Nordenskjold's hut was safe and secure. By spring he was ready to set out exploring.

Swedes were familiar with cold icy conditions, and had used skis and sledges at home. But most Englishmen had not. This was a great disadvantage to the British expedition led by Robert Scott who was setting out on a similar trip to Nordenskjold's, four thousand kilometres away on the other side of Antarctica.

Nordenskjold walked and skied six hundred and forty kilometres with two men, two sledges, five dogs and three hundred kilograms of equipment and food. He arrived back thirty-three days later, suffering from frostbite and snowblindness. He had lost six kilograms in weight.

Nordenskjold's trial journey was important, although not for any special discoveries. It had shown that travel in the Antarctic was possible. The use of dogs with the sledges had worked well.

That summer the sea ice did not break up as expected. Nordenskjold's ship could not get through the ice to pick up the Swedes and they were forced to spend another winter at Snow Hill Island. Short of food, they survived by killing thirty seals and more than four hundred penguins. They managed to avoid the deep depression which had afflicted the *Belgica* by working hard at their research and observation programme. They collected a vast amount of valuable scientific information.



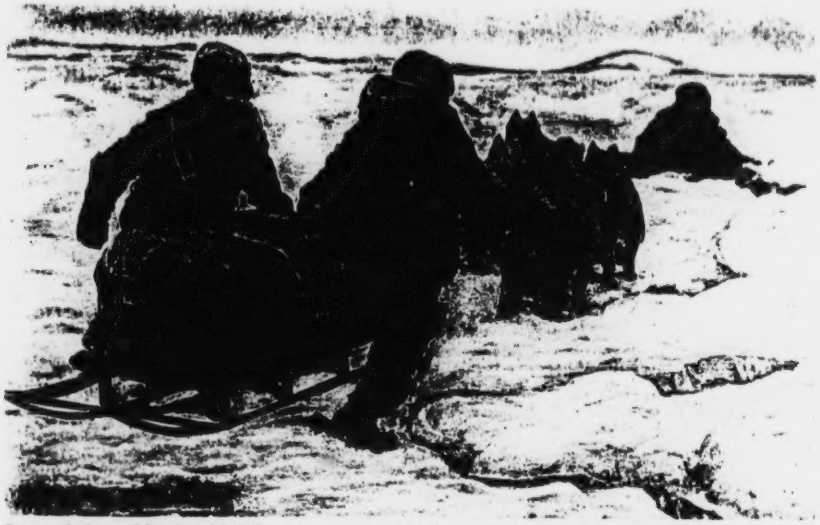
Otto Nordenskjold led the Swedish expedition of 1901-04, claimed to be the most scientifically important to that date
(Crowther Collection).

Indeed they set off at such a pace we had to run to keep up with them ... The dog-drawn sledge weighed 485 pounds (220 kilograms), the man-drawn sledge 200 pounds (91 kilograms), and I was amazed to find that the five dogs could pull their sledge quite easily, whereas the three men were hard put to get theirs on the move. The dogs in fact appeared to find it quite difficult to go as slowly as we did.

On skis to Snow Hill Island. Nordenskjold's expedition, 1904 (Crowther Collection).

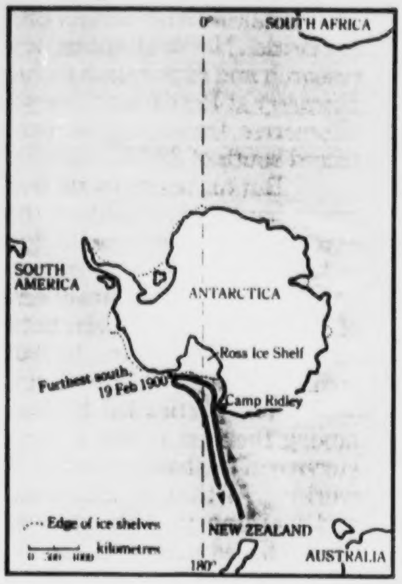
The *Antarctic* never came back. On the way to pick up Nordenskjold, the ship was trapped in the ice. After a month, pressure from the ice squeezing at its sides became too much.

It sank about forty kilometres from land but the crew managed to make their way across the ice to shore. They built a stone hut, killed over a thousand penguins to ensure a food supply, and settled down for the winter. When summer came, they struggled to reach the base camp at Snow Hill Island. The next day a rescue ship arrived to take Nordenskjold and the scientific team, with the crew of the *Antarctic*, to safety.



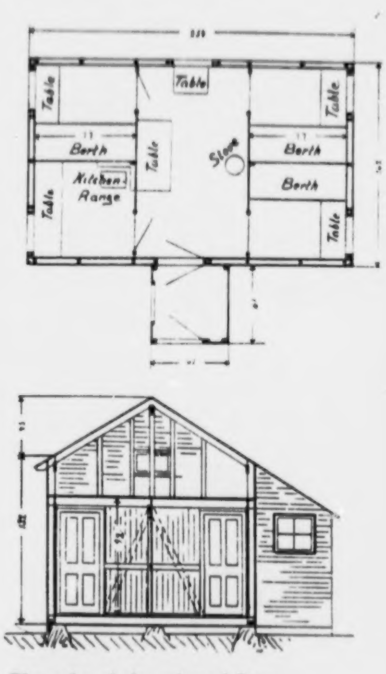
Several times Nordenskjold's men sank through snow bridges into crevasses (Crowther Collection).

Borchgrevink, 1898-1900


0°
SOUTH AFRICA
SOUTH AMERICA
ANTARCTICA
Ross Ice Shelf
Furthest south, 19 Feb 1900
Camp Ridley
Edge of ice shelves
0 500 1000 kilometres
NEW ZEALAND
180°
AUSTRALIA

Skottsberg recorded:

Late in the evening, the pressure begins to build up, the vessel trembles like a leaf, and a violent crash has us all rushing on deck. The scene is terrifying. The Antarctic *is being lifted bodily up, stern first ...*



Table
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Berth
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Stove
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Kitchen Range
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Plan of and elevation of Otto Nordenskjold's hut at Snow Hill Island. He chose the site because of the interesting fossils in the area. Six men spent two years in the tiny hut (Crowther Collection).

Scott (1901-04)

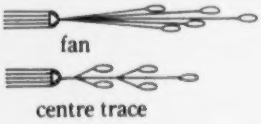
Robert Falcon Scott was an English naval officer who was put in charge of the British National Antarctic Expedition in 1900. Scott did a lot of useful research and exploration on his first trip to Antarctica. Based on the ship *Discovery* at Ross Island, his scientific parties sledged over five thousand kilometres. On one trip he reached the closest yet to the South Pole, a new record south of 82°16′.

But his teams found travel harder than Nordenskjold. The British group hauled their sledges themselves. They had not had the Swedes' experience of working with dogs. Their efforts to control a team ended up in "a welter of snarling animals and tangled harness".

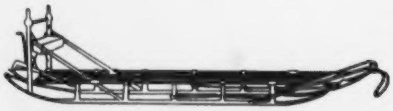
In 1902 Scott's team sent up a manned balloon for the first survey of the region from the air, but further air exploration had to wait for the coming of the aeroplane. In 1904, Scott returned to England determined to come back to the Antarctic again.

The parties led by Borchgrevink, Nordenskjold and Scott were among the first to live in Antarctica and explore the land surface. To survive in the harsh climate, they had to be lucky, courageous and hard-working. All three expeditions brought back many practical ideas on living and working in Antarctica as well as completing valuable scientific research and mapping. This was at the beginning of what is called the "heroic era" of Antarctic exploration.

Probing a crevasse to check its width on one of Scott's expeditions (Crowther Collection).



SLED HITCHES

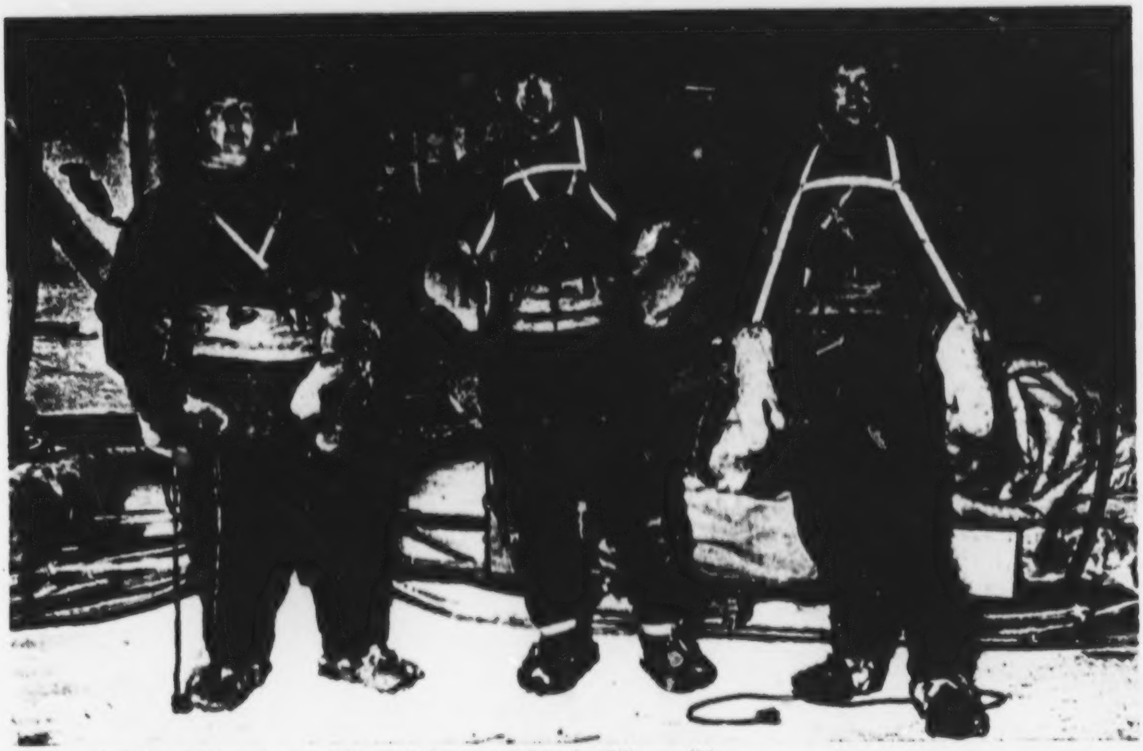


MODIFIED "NANSEN" SLED

Activities

1. Why was Borchgrevink's expedition important?
2. What helped Nordenskjold's party to handle their second winter?
3. In 1902 Scott went aloft in a tethered balloon. Describe what he saw.
4. Why did the Swedes find it easier to work in Antarctica than did the British?
5. What useful information did the three expeditions bring back for other explorers?

Midnight in the Antarctic summer (H. Ponting, National Library Australia).

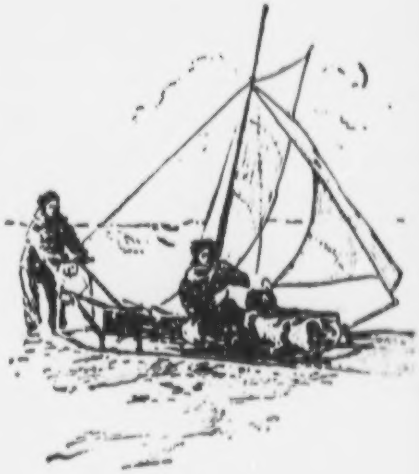


Outdoor clothing of the heroic age. This is Lt Bowers of Scott's 1911 expedition (Crowther Collection).

Chapter 6

Coping with the basic problems

Clothing, food, shelter and travel in Antarctic conditions - these four basic problems continued to worry the explorers. No one had much experience of living and working in Antarctic conditions, but the Norwegians and Swedes had the advantage of coming from countries with long, cold winters and plenty of snow. They had much more practical experience of the equipment needed in the Antarctic summer.



Sledge sailing on de Gerlache's 1897-99 expedition (Tasmanian Collection, State Library of Tasmania).

Travelling

An immense practical problem was travelling with supplies into the interior. The solution was the sledge - but what should pull it across the icy hills and valleys?

Each sledge was about three and a half metres long, made out of hickory and ash wood, and weighed twenty-five kilograms. A sledge carried about four hundred kilograms. It was light and flexible so it could glide over uneven surfaces. The smaller supplies like food were carried in wooden boxes. Tents, sleeping bags, axes, shovels, a cooker and larger items were lashed on top. Some expeditions put a bamboo mast at the front of their sledges. They used a sail to help them along.

The sledges could be pulled in different ways. In his later trip to the Pole, Scott experimented with ponies from Siberia and mules from India, but they could not handle the severe conditions. Scott had to shoot them all in the early stages of his trip.

Ernest Shackleton came to Antarctica in 1907. He tried Manchurian ponies, and also experimented with one of the latest machines, an Arrol-Johnston four-cylinder motor car. Its maximum speed was twenty-five kilometres an hour, and it could travel up to five hundred kilometres. The driver sat in the open air. The car only worked over short distances. It was not powerful enough, and the clutch gave problems. Its best performance was hauling sledges for fifty kilometres in a temperature of minus 34ºC. In fact, none of the early cars or tractors were up to the task. Scott's two Wolseley tractors broke down when an axle split and a cylinder cracked under the extreme conditions.

Team members could haul the sledges themselves, wearing canvass harnesses. Men could manage about ninety kilograms each.

Kamik the husky at Davis Station (Antarctic Division, Australia).

Husky dogs from Greenland and Labrador could also be used, to save the strength of the team. Borchgrevink was the first to use sledge dogs. Nordenskjold found them strong and eager to work. They were used to an extremely cold climate. Their thick double-layered coats gave them lots of protection, and at night they snuggled themselves into snow drifts. The only time they felt uncomfortable was when the temperature rose and melted snow made them wet.

The huskies wore harnesses across their chests and around their front legs. They pulled in teams of six to twelve, depending on how heavy the load was. Each dog could haul from fifty to ninety kilograms. When the ice was safe, the dogs were hitched in pairs to the main lead. If there was a danger of the dogs falling into crevasses, they would be hitched in a fan pattern.

The choice of how sledges were pulled could mean the difference between death and survival. Many methods of hauling - man, dog, tractor,

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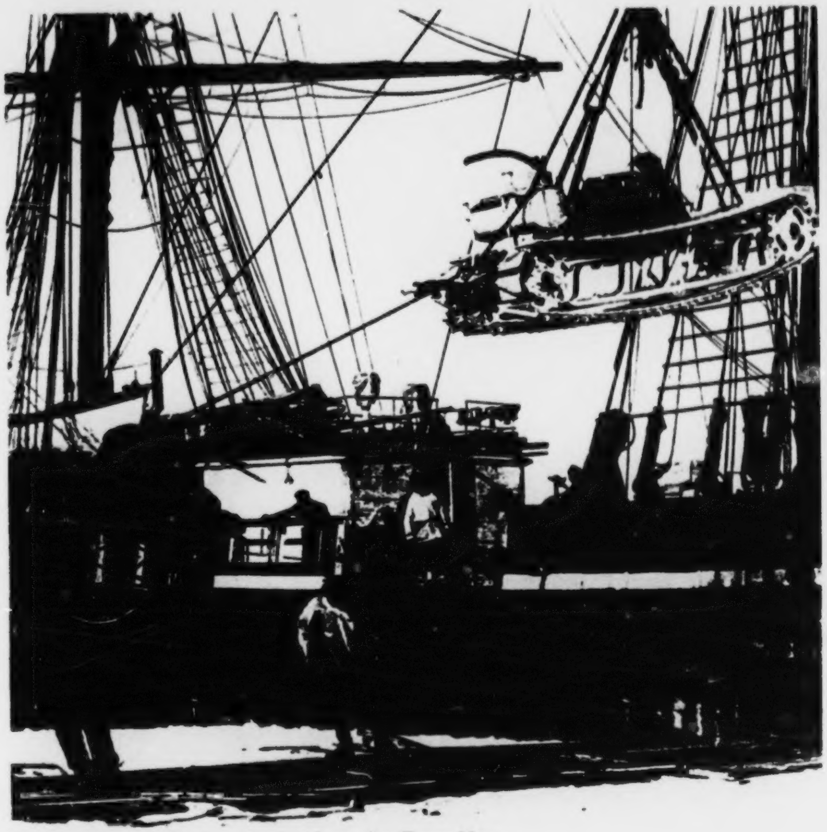
pony, even a wingless aeroplane – were tried. Success or failure depended largely on the choice the team leader made.



Scott's motor sledge is unloaded from the *Terra Nova*.

Man-hauling on a survey trip (Antarctic Division, Australia).

Dog team and handlers running across the ice (Antarctic Division, Australia).

The pony Quan about to haul a loaded sledge. Shackleton expedition, 1907-09.

Mawson's 1912 "air tractor", intended for towing sledges. It failed (Antarctic Division, Australia).

Shackleton's Arrol Johnston was the first car taken to Antarctica in, 1907. It did work, but only over short distances (Antarctic Division, Australia).

Food

Food had to be carefully chosen. It had to be light, because the team had to haul their food along on sledges. It had to be rich in energy and easy to prepare. Pemmican, a food prepared originally by North American Indians, was adapted to suit the Antarctic explorers.

Pemmican Antarctic-style was a paste of dried meat powder mixed with beef fat in 50:50 proportions. Sometimes dried vegetables had been added to the powder. Pemmican was generally mixed with hot water to make "hoosh", a form of stew. Anything else the explorers had might be thrown in, most often oatmeal. Hoosh was eaten with biscuits and washed down with tea or cocoa.

Food was heated in a Nansen cooker. This was a large pot, with a smaller pot fitted inside. Food was put in the smaller pot and ice was packed around it in the larger one. A primus stove was placed underneath. As the food was being heated, the ice melted into drinking water.

Because the team worked so closely for a long time, it was important to avoid fights or arguments. Meals were divided into equal parts. Then one person would turn away from the food. The cook ("mess-Peggy") would point to a plate and ask: "Whose?" The man who could not see the plates would name one of his tent-mates. Then the cook would point to a second plate and the man would name another tent-mate.

This was the fairest way of sharing out the food, and it was called "whose-ing" the food. It avoided trouble and one cause of people irritating each other.

Explorers were aware of the possibility of scurvy, the disease caused by lack of fresh food. Borchgrevink had dehydrated vegetables in 1898, and later Amundsen added dried vegetables to his pemmican. When possible, they ate seal meat or penguin. But they could only hunt along the coast. Neither of these animals went inland.

Teams who were stranded or ran out of food survived on anything they could catch. One group caught a sea leopard. When they cut it up, they found fifty freshly swallowed fish inside. The fish were still in good condition and were eaten again, this time by human beings.

Other groups counted on their sledge animals as a source of fresh food in the icy wilderness. Amundsen made a tasty stew out of some of his huskies. Scott would have eaten his ponies, but they did not survive the march. Douglas Mawson was forced to eat what was left of his dog-team after all his supplies disappeared into a crevasse.

Food was carefully weighed and measured before the explorers set out. Each day's ration was packed in its own container.

The weight totalled a little under one kilogram. Each day away from the base required nearly one kilogram per person in food supplies.

This is a list of the daily food ration for one person on Mawson's expedition of 1912:

350gm	*plasmon biscuit (wholemeal flour and milk biscuit)*
220gm	*Bovril pemmican (powdered dried beef with fifty per cent beef fat added)*
60gm	*butter*
60gm	*Cadbury's chocolate*
140gm	*Glaxo dried milk*
110gm	*sugar*
30gm	*cocoa*
10gm	*tea*

Shelter

Explorers lived in a hut at their base camps during the winter. They used tents on their summer trips of exploration. Their huts had to be strong and well-insulated. Building is difficult in Antarctic conditions, so the huts were made back at home. They were carried in sections on the voyage and bolted together when the team landed.

When Amundsen arrived in the Antarctic, he bolted the separate sections of his prefabricated Norwegian house together and wired it down to the ground. Scott's hut of 1910-13 was bigger than Amundsen's, sixteen metres by eight metres. He added quilted layers of seaweed to the walls and floor to keep in the warmth. The floor was in five layers.

All the huts had an entry porch with two doors. This stopped the wind getting in, and the heat getting out. It was also a place to hang frozen outer clothing. The porch was the same temperature as the outside, so clothes stayed frozen. If they were taken inside, the ice on them would melt and they would get wet. Camera, goggles and instruments were also left in the porch. Inside in the warmth of the hut, the cold surfaces of these would be covered with condensation. As soon as they were taken outside, the condensed water would freeze and perhaps jam the instruments.

The explorers' tents had to be light and strong. They had to be tied and weighted down so they would not blow away in an Antarctic blizzard. They also had to be easy to put up in the worst weather conditions and be windproof. Each tent had a wide skirt around the base. Blocks of ice were piled on this skirt to stop the tent being blown away. It was entered by crawling up a canvas tunnel, rather like the sleeve of a jacket. The tunnel could be closed off against the wind with a drawstring.

Tent, showing ice-covered skirt and canvas entry tunnel.

Explorers used different types of tent. Scott joined five bamboo poles with a canvas strip, then threw a light windproof tent over the top and tied and weighted it down. Amundsen's tent was easier to erect. He used one pole, and it was put up by one person from inside. It had a built-in floor to stop the people getting wet from melted snow.

The tents were usually big enough for three people to sleep and cook in. The person in the middle was the warmest - but he had to kneel down to act as the bench when it came to cooking food. If explorers were caught in a blizzard, they might have to lie in their sleeping bags for a week. To save precious food, they would cut their rations by half while they were tent-bound.

Tents today are usually brightly-coloured so they can be seen easily from the air or ground. Amundsen dyed his tents with ink and black shoe polish. He wanted to give his team some colour to look at, as a relief from the relentless white of the landscape.

Clothing

Like all the food and equipment, clothing was carefully adapted to the Antarctic. Correct clothing was essential. It had to hold in body heat and block out cold winds. Three or four layers of woollen garments were worn. The outer windproof clothes were made of a tightly woven cloth of fine wool or cotton called gabardine. This was made up into jacket and trousers.

Underwear and undergarments were soft and loosely knitted. Warm air was trapped in tiny air pockets between the threads. The clothes had to fit snugly at the neck and wrists to stop the warm air escaping. They fitted loosely over the rest of the body, and warm air could be released by loosening the collar if the wearer got too hot. The sweat of a person working hard would freeze when work stopped if the moisture was not allowed to escape. Heads were protected by woollen balaclavas covered by fur-edged hoods.

Extreme cold and wind can freeze the extremities and exposed parts of the body, such as toes, fingers, cheeks, nose or ears. Blood cannot pass through this frozen flesh and so it turns white. This is called frostbite.

Frostbite occurs without warning or pain. It is after only a slight tingling and a stiffening of the area affected that all sense of feeling is lost.

Frostbite was - and still is - a serious menace. Scott's expedition to the Pole suffered badly:
Cherry's finger tips are all pretty badly blistered ... The frostbite has gone deeper than we thought. He may lose the end of the finger, and the thumb nail will be lost for good ... The damage is so deep that it may turn out the bone is exposed ... Titus's big toe is turning blue-black ... Evans' fingernails all coming off, very raw and sore ... nose very bad and rotten looking.

Serious frostbite can cause the loss of exposed parts of the body (Crowther Collection).

Often a person does not know about the frostbite until a friend has noticed the tell-tale white spots. Blisters form on serious cases.

The usual treatment is to apply gentle warmth – to press a warm hand on a frostbitten face, to put frostbitten fingers up under the armpits, to bathe frostbitten toes in warm water. As soon as the treatment starts to hurt, the danger of frostbite is over, because this means the blood is circulating again.

Dark glasses or snow goggles were worn to prevent another serious disorder, snowblindness. Snowblindness is caused by the glare of sunlight shining off the icy white surface into the eyes. It causes a gritty pain in the eyes, "as if someone had thrown a handful of sand into them".

Ultra-violet rays from the sun reflect off snow, ice or water. Wearing dark glasses cuts down this glare. Mawson advised a member of his expedition to "screw your eyelids (up) as tight as you can. You have to cut down the amount of light reaching your eyeballs.".

The only cure for mild snowblindness is to keep the victim blindfolded or in a dark room. This may take days. Early explorers treated the pain by putting small tablets of cocaine and zinc sulphate under the eyelids. Bad snowblindness may permanently damage the eyes and the only cure yet devised is a corneal transplant.

Three layers of cover protected the hands – two pairs of woollen gloves to keep them warm, and fur mitts to keep out the wind. The teams also wore three pairs of socks, each larger than the one before. Sometimes "finnesko", or fur boots made out of reindeer skin, were worn over the top. These boots were stuffed with a special grass, "sennagrass", as further insulation. They also used special boots, to which they could strap skis or crampons. Crampons were spiked iron plates which helped the boots grip into slippery ice slopes.

In winter the expeditions were forced to stay in their huts until the sun shone again. They used some of their time to improve clothing and tents. The sewing machines ran hot as they made and remade clothing. Boots were unpicked and sewn up again. Tents were modified to make them more suitable for Antarctic conditions, and sledges strengthened and lightened. Harnesses for the dogs were designed and made. All the equipment had to be tested, and changed if necessary. By summertime, the explorers were ready. An unknown continent stretched out before them.

Modern cold weather clothing.
1. Thermal underwear and socks, over normal underwear (N.R. Kemp).

2. Heavy woollen shirt, braces, mohair pants liners, woollen gloves and quilted inner liners on feet (N.R. Kemp).

Mealtime in a tent. Evans, Bowers, Wilson and Scott huddle around a Nansen cooker on the way to the Pole, 1911 (Crowther Collection).

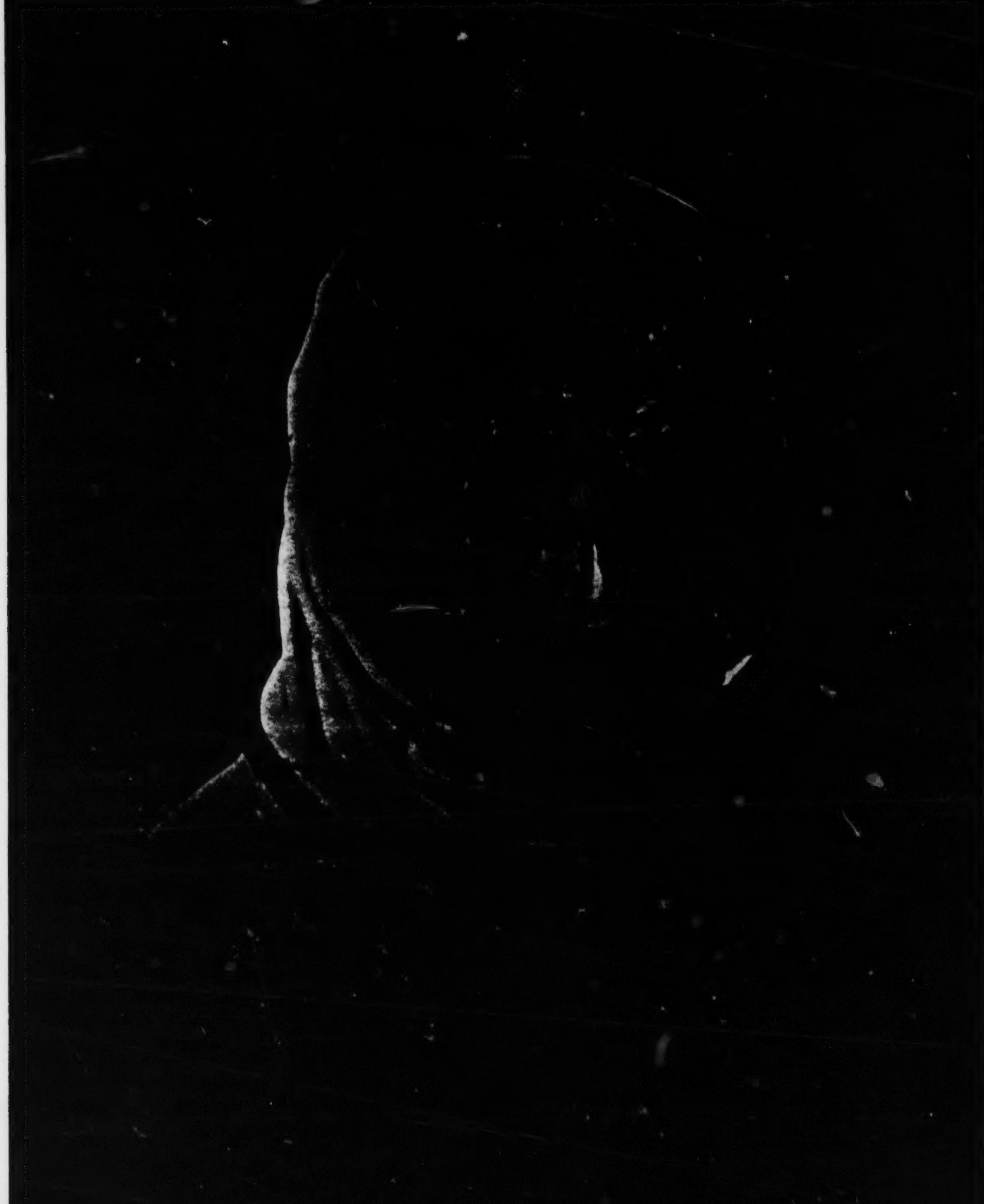
Activities

1. Rank the different methods of pulling sledges, giving the advantages and disadvantges of each one.
2. Draw a labelled diagram of a Nansen cooker.
3. Work out another way of sharing the food out fairly.
4. What are the symptoms of scurvy? How can it be prevented?
5. Make up a daily ration of modern foods for a polar expedition. Remember you have to carry everything and you may be away for some months.
6. Why did explorers choose the clothes they wore?
7. Research the husky dog and the sledges it pulled.
8. Exactly how much did the daily food ration for one person on Mawson's expedition weigh?

3. Woollen balaclava and jumper, wind-proof cotton pants, woollen/nylon mittens and quilted outer liners on feet (N.R. Kemp).

Antarctic summer clothing
(L. Goldsworthy, Fund for Animals).

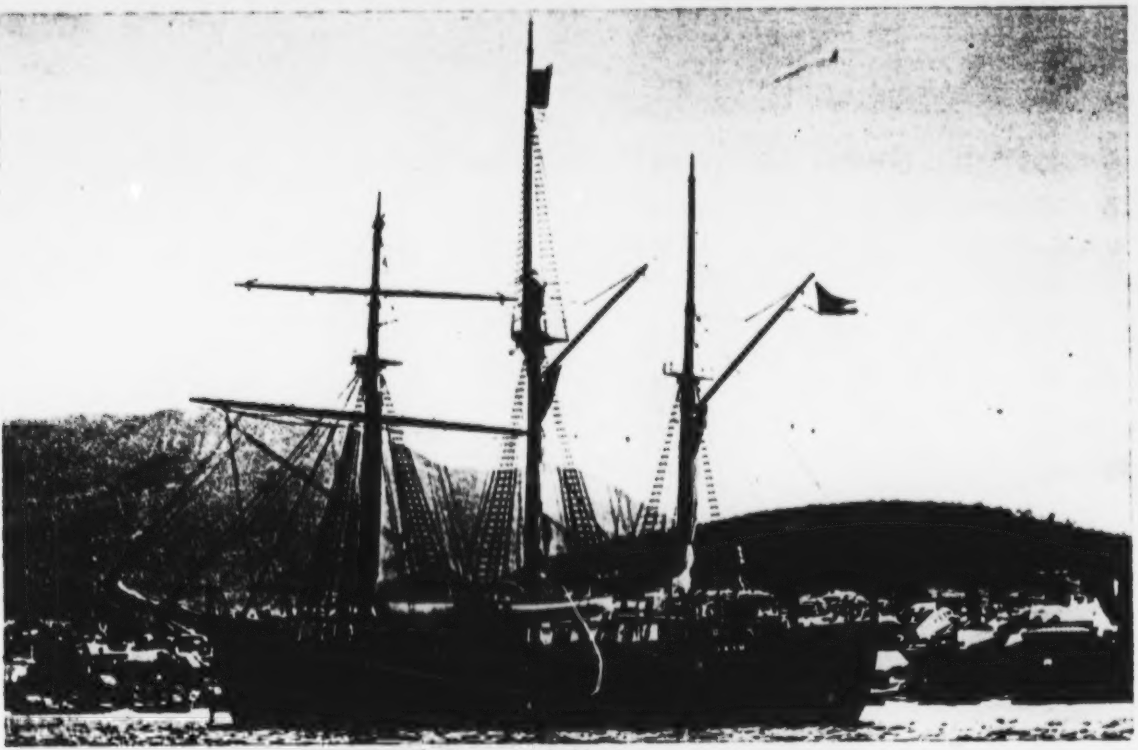
4. Sunglasses, parka, leather mittens and fur-backed bear mitts, mukluks (rubber-soled with canvas uppers) on feet (N.R. Kemp).



Roald Amundsen. Polar exploration had been his ambition since childhood.
([illegible] Museum)

Part 2

Robert Falcon Scott. This picture is by famous Antarctic photographer Herbert Ponting (Antarctic Division, Australia)



Amundsen's *Fram* in Hobart on the way south (Tasmanian Archives).

The first men to reach the South Pole. Amundsen and his party in Hobart on board the *Fram* (Tasmanian Museum).

Chapter 7

Amundsen and Scott: the race for the Pole

On 5 January 1911, Robert Falcon Scott landed at McMurdo Sound from his ship *Terra Nova*. Ten days later the *Fram* arrived at the Bay of Whales, seven hundred and seventy five kilometres away along the Ross Ice Shelf, and Roald Amundsen began unloading his equipment. The race to the South Pole had begun ...

Preparing for the Pole

The two leaders were very different people. Scott was an English naval officer, used to strict Royal Navy discipline and traditions, and going to the Antarctic was part of his career. Scott planned an extensive scientific program, but his chief aim was to be first to reach the Pole. His plan was to follow a route pioneered in part during his first expedition with Shackleton and Wilson nine years earlier, and followed by Shackleton in 1908-09. It lay across the Ross Ice Shelf, up Beardmore Glacier, and across the high polar plateau to the Pole – a distance of fifteen hundred kilometres. Scott's first attempt had foundered before he could reach the Glacier. Shackleton got farther seven years later – up onto the plateau, and to within a hundred and eighty kilometres of his goal.

In the two years it spent in Antarctica, Scott's expedition was to undertake a huge amount of valuable exploration and research. His teams mapped hundreds of kilometres of unknown territory along the west coast of the Ross Sea, and parties had terrible winters in tiny camps at Cape Crozier and Cape Adare. In contrast, Amundsen's team had only one aim – to get to the South Pole first.

Amundsen came from Norway, a land of snow and skis, and had dreamed of polar exploration from his boyhood. He had spent his adult years trying to find the best ways of living and travelling in polar conditions. Originally he intended to aim for the North Pole but, just as his expedition was about to set out, the news came that Peary had reached that goal. So Amundsen changed his target from the North to the South Pole.

The Bay of Whales was one hundred kilometres closer to the Pole than Scott's landing-point, McMurdo Sound. Amundsen would have less

Amundsen's base at Framheim, 1911 (Antarctic Division, Australia).

Scott sent up balloons to test the air currents (Crowther Collection).

distance to travel, but he would have to discover his own way off the ice shelf up on to the plateau. The explorers had a strong sense of honour in the race. Amundsen did not want to trespass on Scott's planned route up the Beardmore Glacier. Both teams spent the rest of the summer in preparation for the journey which would begin when winter ended that year.

While still in Europe, Amundsen had decided on his solution to the transport problem. He was going to use husky dogs to drag the supply sledges. He had brought one hundred of the finest huskies from Greenland, along with an experienced sledge driver to help the others in his team. The five explorers were to travel on skis.

Scott had not yet chosen between huskies, motor tractors and Siberian ponies to pull his sledges. In fact he liked the idea of people hauling their own supplies. His team had not had enough experience with dogs and did not understand how to get the best out of them. Antarctic conditions turned out to be quite unsuitable for the ponies, and the motor tractors kept breaking down. Besides, Scott thought the noble and gallant way of reaching the Pole was by human effort alone, without the help of animals.

While the British were working out their transport problem, the Norwegians spent the summer setting up a series of supply depots towards the Pole, out across the ice shelf. At 80°S, one hundred and thirty kilometres from the Bay of Whales, they deposited two tonnes of food, fuel and dog food. Smaller supply depots were made at 81°S and 82°S. So, by the end of summer sledging weather, Amundsen had marked his route for the first part of the next year's trip. He had tried and tested all his equipment under Antarctic conditions, as well as laying three supply depots.

The Norwegians spent the long hours of winter darkness improving their equipment. The sledges were lightened, boots taken apart and re-sewn, and the tents enlarged. Food was counted and packed into containers, and fur clothing was altered. By springtime, Amundsen was ready.

Scott's group also had a busy period over the winter. They had lectures on all sorts of subjects, played football and did exercises. Scientists started valuable research work into weather, geology and other disciplines. Several trips were made. A team of three spent five weeks in the middle of winter going to fetch eggs of the emperor penguin, a trip later described as the "worst journey in the world".

The motor tractor was to haul Scott's supplies to the top of Beardmore Glacier. It broke down and was abandoned (Crowther Collection).

Man-hauling was backbreaking work. Scott took this photograph (Crowther Collection).

Scott had decided to use all his different types of transport to move the polar party across the ice shelf to the foot of the Beardmore Glacier. Then the motor tractors, the dog-teams and the ponies would turn around and go back to the base. Those going on to the Pole would pull their own sledges.

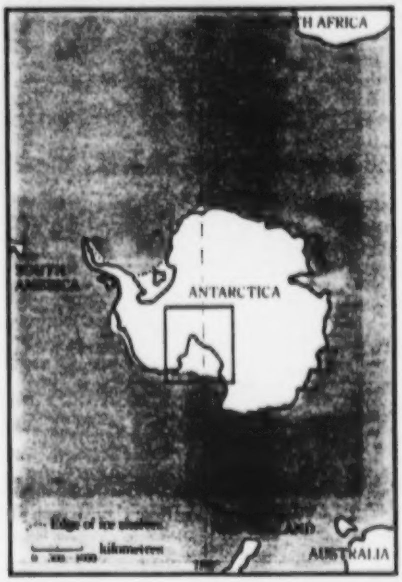
Scott, though, was still not ready by spring. He had managed to lay only one small supply depot. His crew had not practised skiing or driving a dog-team over the winter. The equipment had been overhauled, but only by the ratings, not the officers who were going on the trip. The tents let in snow and were hard to put up. Drift snow jammed the sledge-meter, so the party could not tell how far it had travelled. Only at the last minute did Scott start to think about the rations the Pole party would carry.

Winter was a nervous period for both camps. Neither group knew what the other was planning. When would the Norwegians start? Amundsen worried that the British motor tractors might work too well. Scott began to wonder whether dog-teams might not be the quickest way of travelling after all.

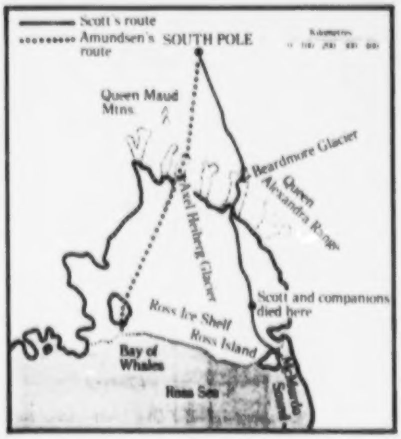
The Norwegians made a nervous false start on 8 September but were forced to turn back by temperatures so low that the liquid in the compasses froze. Both camps had to sit and wait for the end of the long, cold winter.

Members of Scott's party haul up a fish-trap (Crowther Collection).

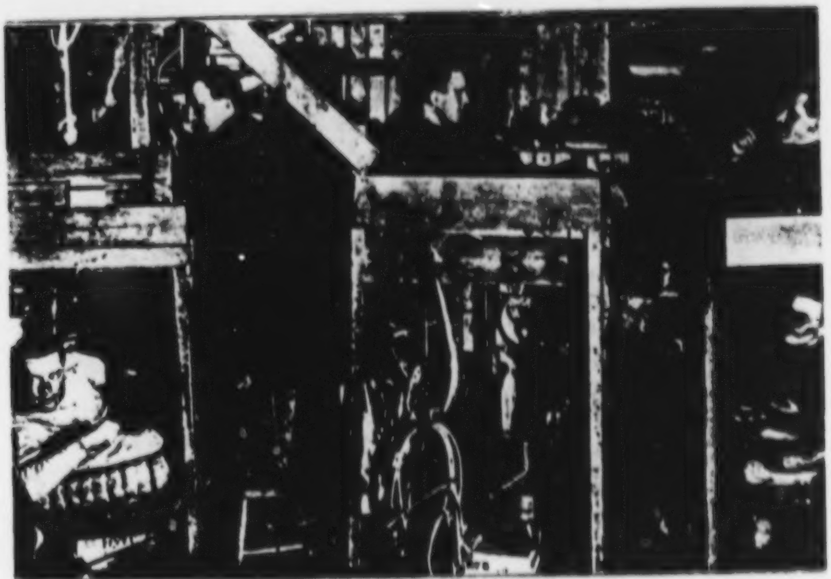
Amundsen's and Scott's routes, 1911-12



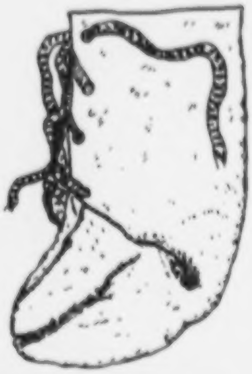
H AFRICA
SOUTH AMERICA
ANTARCTICA
Edge of ice shelves
kilometres
AUSTRALIA



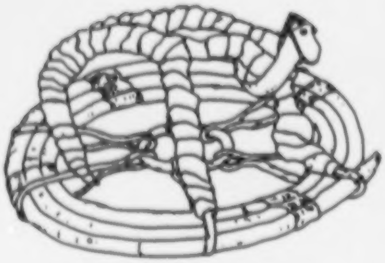
Scott's route
Amundsen's route
SOUTH POLE
Kilometres
Queen Maud Mtns
Beardmore Glacier
Queen Alexandra Range
Axel Heiberg Glacier
Scott and companions died here
Ross Ice Shelf
Ross Island
Bay of Whales
Ross Sea
McMurdo Sound



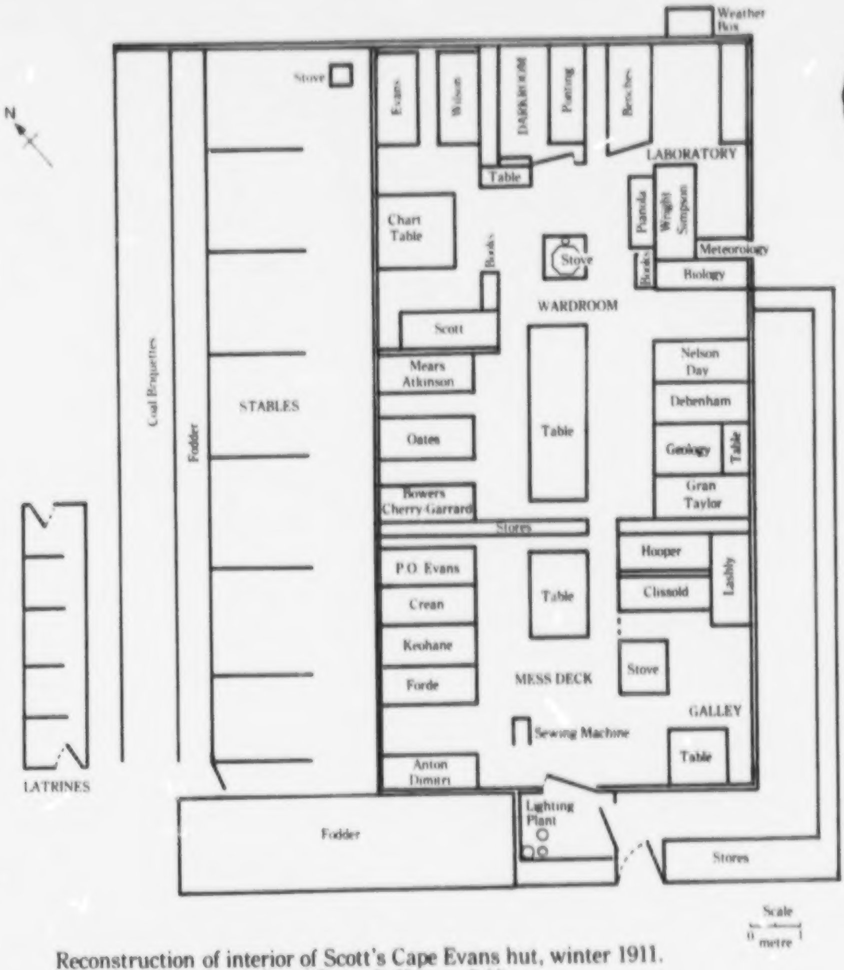
The Tenements - officers' quarters at Scott's base (Crowther Collection).



LEATHER BOOT FOR SLEDGE DOG



PONY SNOWSHOE


Weather Box
N
Stove
Evans
Wilson
DARKROOM
Ponting
Benches
LABORATORY
Table
Chart Table
Books
Stove
Pianola
Wright
Simpson
Meteorology
Books
Biology
WARDROOM
Scott
Mears Atkinson
Nelson Day
Debenham
Coal Briquettes
Fodder
STABLES
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Geology
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Bowers Cherry Garrard
Stores
P.O. Evans
Hooper
Lashly
Crean
Table
Clissold
Keohane
Stove
Forde
MESS DECK
GALLEY
Sewing Machine
Table
Anton Dimitri
LATRINES
Lighting Plant
Fodder
Stores
Scale
0 1
metre

Reconstruction of interior of Scott's Cape Evans hut, winter 1911.
Occupant of top bunk listed first. (D. Harrowsfield)

"The dogs were eager to get away." Amundsen starts his journey to the pole on 20 October 1911 (State Library of Tasmania).

The race is on

Amundsen set off on 20 October 1911, heading directly south across the ice shelf. The dogs were fresh, the sledges light, and they averaged forty kilometres a day. They had time to rest at the first depot before packing supplies onto the four sledges. As they moved further south, the route was carefully marked with flags and snow beacons.

The first of the British team set out with their two motor sledges on 24 October 1911. Scott, with the ponies, left to follow them on 1 November. Then the dog teams set out. By early November the expedition - sixteen men, ten ponies, over two hundred dogs and thirteen sledges - was spread over eighty kilometres of the ice shelf. The bulk of the expedition comprised support teams. They were to set up dumps of food and fuel along the route.

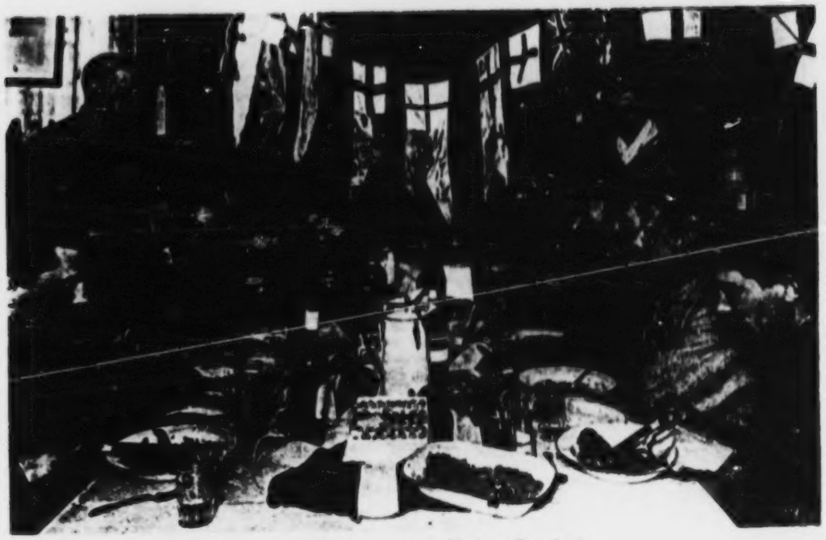
Already the party found the going tough. The motor tractors broke down and were abandoned. Man-hauling some of the sledges was now necessary, and it was exhausting work. One of Scott's team wrote: "We are simply jerking our insides out to no effect." The ponies floundered along, sinking belly-deep in the soft snow. Starved, tired and frozen, they were finally shot three kilometres from the foot of the Beardmore Glacier. It was only the efforts of the dog-teams that kept the expedition moving.

Already, Scott was falling behind in the race. He had taken thirty-eight days to cross the ice shelf. Amundsen had covered the same distance in twenty-nine days. It had been easy travelling for Amundsen and back-breaking labour for Scott.

Amundsen arrived at the foothills of the Queen Maud Mountains on 16 November. He had to find a way up this mountain range on to the polar plateau. He took the first path that looked possible - there was no time to search for an easier route.

The Axel Heiberg Glacier is steep and treacherous. In places the sledges had to be hitched to double dog-teams to move them upwards. Amundsen and his team met all the obstacles head-on. In four remarkable days they found a new route from the shelf to the plateau, climbing three thousand metres and travelling seventy kilometres closer to the Pole.

Three times men or dogs from Amundsen's team fell into splits in the ice. Ice cracks occur as the huge sheets of ice covering Antarctica slide



Scott's last birthday (Canterbury Museum - photo Herbert Ponting).

slowly down to the sea, at speeds of about two metres a day. These ice rivers are called glaciers. As they slide over obstructions in their path, the ice surface splits open. These splits are called crevasses.

In other expeditions, too, crevasses have claimed vehicles, and animal and human lives. On one of Douglas Mawson's expeditions, his companion Belgrave Ninnis, together with the sledge carrying supplies and the dog-team, were all lost down one of these splits in the ice surface. Sometimes crevasses are covered by a thin bridge of ice, making them invisible on the surface. People travelling on skis or sledges, or in tracked vehicles, have to spread their weight over as much snow as possible. They rope themselves together for safety. The harness of a husky is specially designed not to slip off a dog dangling in a crevasse.

The base at the top of Axel Heiberg Glacier was called "The Butcher's Shop". Fresh meat was needed for both dogs and people, and now that the steep climb was completed fewer dogs would be required. So the Norwegians shot twenty-four of their dogs and fed most of them to the remaining eighteen. A young dog call Rex was chosen as being particularly tender, and he was made into a stew for the five explorers.

Amundsen planned to shoot half the remaining dogs as the trip went on. He would not need them to haul the sledges as supplies were used up, and the food the dogs needed took up valuable space. He did not like doing this: "It was hard - but it had to be so. We had agreed to shrink from nothing in order to reach our goal. Each sledge driver was to kill his own dogs ..."

The Norwegians had to extend their rest from two to four days because of a blizzard. They moved off again with three dog-teams. It was a difficult stage of their trek: slippery ice surfaces separated deep crevasses. Thick fog and blizzards slowed them. They crossed areas they named the Devil's Glacier and the Devil's Ballroom, and passed the Gates of Hell. By 5 December 1911, only three hundred kilometres of fairly smooth snow lay between Amundsen and the South Pole.

On 5 December, Scott had been stopped by a blizzard at the foot of the Beardmore Glacier. His team remained in their tents for four days. Their transport problem was serious, as they could not ski well enough to cope with soft snow. Scott could not afford this delay. Already supplies were running short. He was now well behind Amundsen. The dog teams were turned back. The three remaining sledges would be man-hauled.

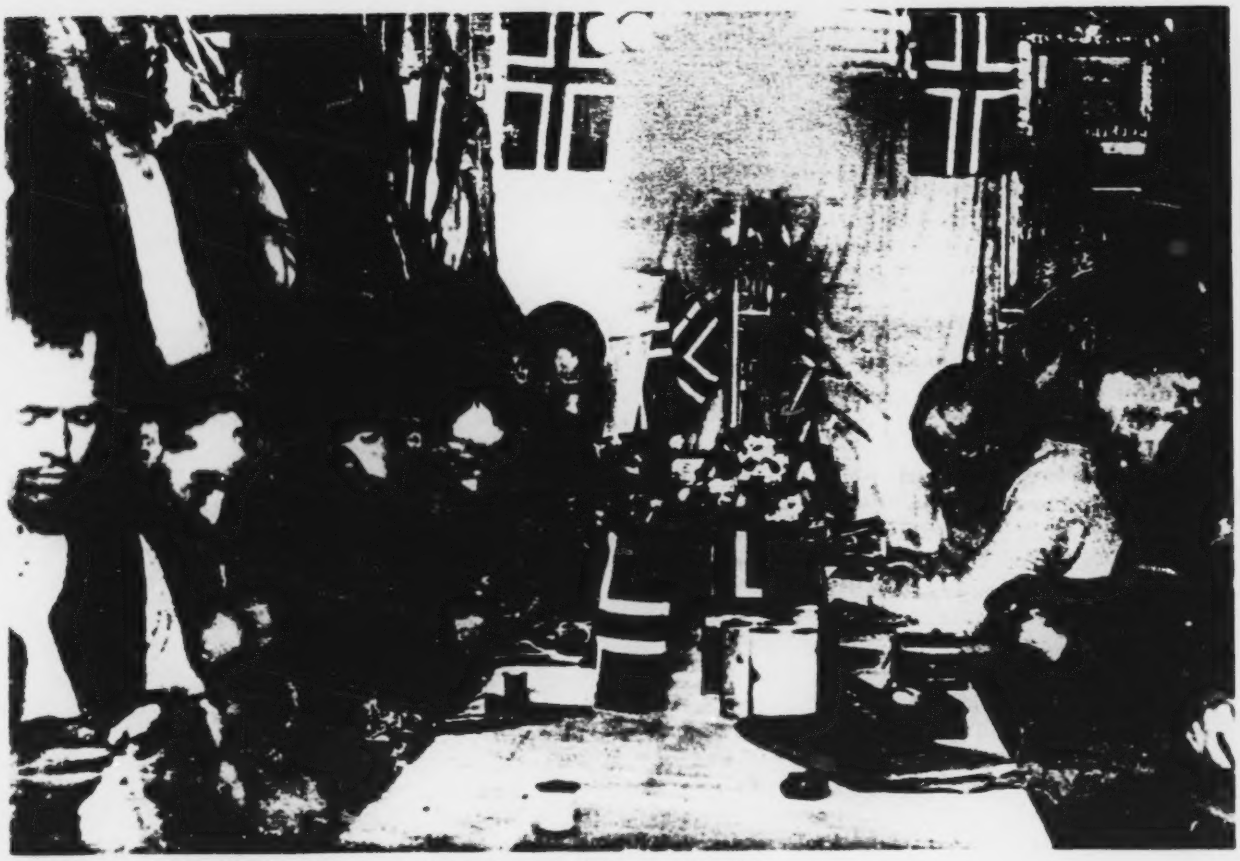
The haul up the two hundred kilometre Beardmore Glacier began in deep, loose snow. Each of the twelve men had a hundred kilogram load to pull. Hauling the sledges, Bowers said, was "the most back-breaking work I have ever come up against ... The starting was worse than the pulling as it required from ten to fifteen desperate jerks on the harness to move the sledge at all ... I have never pulled so hard, or so nearly crushed my inside into my backbone by the everlasting jerking with all my strength on the canvas band around my unfortunate tummy".

Scott was strong and determined. He drove his teams on relentlessly. They hauled nine or ten hours a day, covering about twenty kilometres. By the time the top of the glacier was reached, his whole party had been weakened. It was New Year's Day, 1912.

Dash for the Pole

It was time for the last support party to turn back for the base at Hut Point. Scott was left with a team of four to haul the last sledge to the Pole – Bill Wilson, 'Titus' Oates, Edgar Evans and himself. At the last minute he decided to take 'Birdie' Bowers with him, as he was the best navigator of the group. This decision created a new set of problems. Five people would have to cram into a tent meant for four. Apart from the discomfort, the overcrowding made cooking for five difficult. As Bowers had left his skis behind, he would have to walk. The South Pole lay two hundred and forty kilometres ahead.

Amundsen's party skied on in single file after leaving the Devil's Ballroom. A front-runner encouraged the dogs and kept a straight course.



Midwinter 1911. Amundsen's party prepares for next summer's journey. From left to right: Bjaaland, Hassel, Hanssen, Wisting, Amundsen, Johansen and Prestrud (State Library of Tasmania).

BEST COPY AVAILABLE

Amundsen or Sven Hassell took turns at leading the way. Next came Helmer Hanssen, driving the special non-magnetic sled with the main direction-finding compass. Oscar Wisting drove the second dog-team and Olav Bjaaland the third. The weather had cleared and the only sounds were "the scuffing of skis, the creaking of sledges and the scratching of dogs' feet, with, now and then, the crack of a whip or a shout from one of the drivers".

The tension rose as they neared the Pole. Had Scott beaten them there? It would have been easy to panic and break into a wild race. But Amundsen was aware of how necessary it was to keep a steady, even pace. He kept his nerve and his party drew twenty-five kilometres nearer the Pole each day. Every member strained his eyes, searching for a Union Jack planted in the snow ahead.

The last day was fine. The Pole lay twelve kilometres ahead. Hanssen, the lead sledge driver, asked Amundsen to be front-runner, telling him this would work best with the dog-team. The team members were making sure that Amundsen was the first man to reach the South Pole. They arrived on 14 December 1911.

Oscar Wisting and his dog team at the Pole (State Library of Tasmania).

"And so, farewell, dear Pole. I don't think we'll meet again." Amundsen's party leave the Pole, 18 December 1911 (Tasmanian Museum).

Victory – and despair

There were no speeches, no ceremonies. The Norwegian flag was unfurled, and five weather-beaten fists grasped the pole and thrust it into the snow. They were the first people to reach the loneliest and most desolate part of our planet.

The Norwegians spent the next three days skiing around the area, putting up snow cairns and checking their position. They put up the spare tent to mark the Pole, leaving in it some discarded equipment and letters for Scott and King Haakon of Norway. On 18 December Amundsen turned for home, writing in his diary:" And so, farewell, dear Pole. I don't think we'll meet again."

Scott's party plodded on, not knowing the race was already lost. They were travelling about sixteen kilometres a day and keeping to their timetable. But it was getting late in the season, and colder. Frostbite and hunger worried them, and there was never enough to drink because the stove used to melt ice was running out of fuel. Sticky and loose snow and small ice ridges called sastrugi made progress difficult. They were tired and depressed.

On 16 January their hopes were finally shattered when they walked into one of Amundsen's markers. A black flag surrounded by paw marks told the story. Gloomily they marched on to reach the Pole, built a cairn and photographed themselves in front of the Union Jack.

Scott now had to lead his weary team back one thousand five hundred kilometres to McMurdo Sound. Food was a serious problem. Man-hauling sledges for ten hours a day was exhausting work and they were eating little more than half the food they needed. Both Oates and Evans had wounds that would not heal because their diet lacked fresh food. Scott could not afford to stop and rest because they had no spare supplies. Their race to the Pole had turned into a race for survival.

By this time, the Norwegians were nearly back at the Bay of Whales. They had travelled easily over the plateau with a south wind at their backs. Amundsen limited the men to twenty-five kilometres a day. He wanted them to build up strength for the difficult descent of Axel Heiberg Glacier.

Their troubles were small ones compared to Scott's. The party became lost at the top of the glacier and ran short of dog food before finding the Butcher's Shop depot. Wisting got a bad toothache and Amundsen used forceps warmed by the primus stove to pull the tooth out.

Once they reached the ice shelf on 7 January the trip turned into a sprint. With both men and dogs on double rations and bursting with good health, they followed a clear line of cairns and flags across the ice. On 26 January at four o'clock in the morning the five men tiptoed into the hut where the base crew lay asleep. Amundsen's first words were to the cook: "Good morning, my dear Lindstrom. Have you any coffee for us?"

The British party managed to get back over the plateau and down the Beardmore Glacier. Before they reached the ice shelf they had their first casualty - Evans. Suffering from frostbite and scurvy, injured by falls, broken by defeat and racked with hunger pains, Evans collapsed on 17 February and died in his sleep that night. They were five hundred and seventy kilometres from McMurdo Sound. The team's only real chance now was to be rescued by a dog-team from the base station. On 16 March, with the weather worsening, the exhausted party set up camp.

Oates' frostbitten feet had turned gangrenous. The next morning, aware that he was a burden on his companions, he got out of his sleeping bag and walked out into the blizzard. His body was never found.

Scott, Wilson and Bowers struggled into the blizzard for another four days before pitching their final camp. They were only eighteen kilometres from the One Ton Depot and two hundred and ten kilometres from safety. With better weather perhaps they could have made it, but the wind would not let up. They were trapped, and the effort was beyond their exhausted bodies. They died about 31 March, 1912.

Scott wrote in his diary:
The Pole. Yes, but under very different circumstances from those expected. We have had a horrible day ... this is an awful place and terrible enough for us to have laboured to it without the reward of (arriving first).

The second group to reach the Pole. Left to right: Oates, Bowers, Scott, Wilson and Evans. Bowers triggered the camera by pulling the string visible in his right hand
(Crowther Collection).

Activities

1. How important were the choices of transport that Scott and Amundsen made?
2. Compare the activities of the two groups from January 1911 until they set out in October 1911.
3. Was Amundsen right to eat Rex?
4. Many explorers kept diaries. As a member of either group, make up a diary for one week.
5. Research: Explain these terms:

ice shelf	sledge-meter
polar plateau	compass
glacier	depot

Shackleton and Worsley watch hopefully as the ice around *Endurance* shows signs of breaking up (Mitchell Library - photo Frank Hurley).

Chapter 8

Shackleton: the survivor

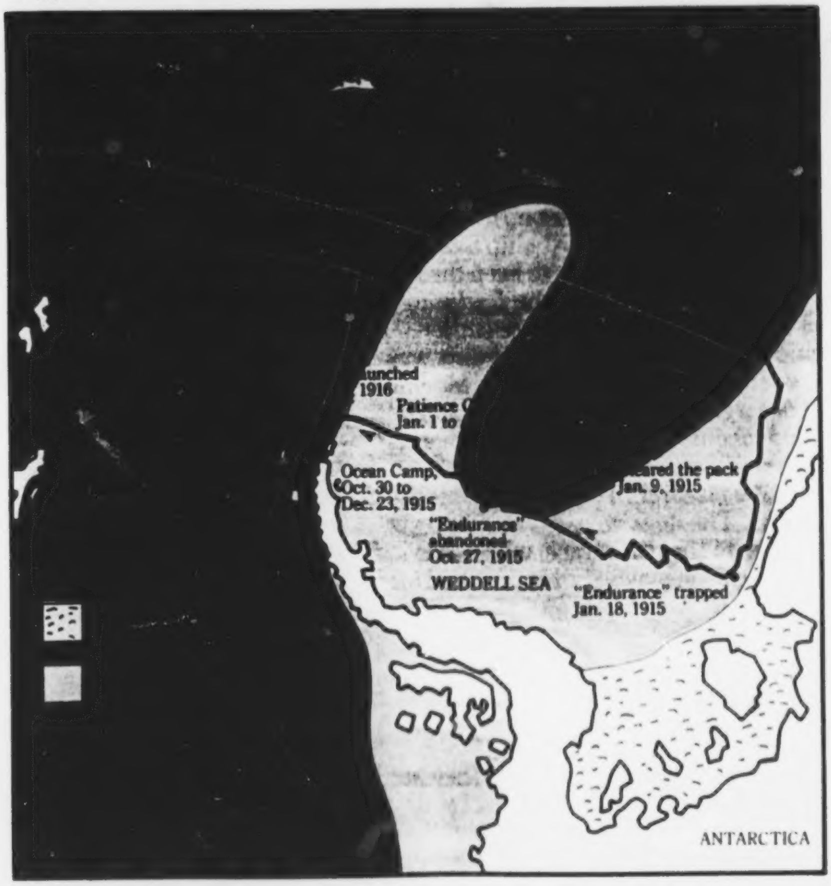
Ernest Shackleton had wanted to be the first to reach the South Pole. He had been to Antarctica twice before, once getting to within a hundred and eighty kilometres of the Pole before being forced back by shortage of supplies. Now Roald Amundsen had got there first. So Shackleton decided there was just one great journey left – crossing Antarctica from one side to the other.

His plan was for his ship *Endurance* to drop him and five others on the Weddell Sea coast. Another group would be dropped off at the Ross Sea on the other side of Antarctica. This group was to meet him at the top of the Beardmore Glacier. The crossing was to take five months at the most.

Shackleton set sail from England on 8 August 1914. By 7 December the *Endurance* was forcing its way through heavy pack ice. Although it looked light and frail, the massive timbers of oak and pine had been specially designed for travel through ice. The *Endurance* had both sails and an engine. In ice it became a battering ram, charging at the ice. The ice would crack and open up for the ship.

Nearing her destination in the Weddell Sea, the *Endurance* made steady progress through open water next to the coast. The further south they could get, the less distance Shackleton would have to sledge. But a blizzard blew up, and the ship took shelter behind an iceberg. When the weather cleared the next day, the ice had thickened. The *Endurance* was trapped.

Sir Ernest Shackleton
(Mitchell Library).


unched
1916
Patience C
Jan. 1 to
Ocean Camp,
Oct. 30 to
Dec. 23, 1915
eared the pack
Jan. 9, 1915
"Endurance"
abandoned
Oct. 27, 1915
WEDDELL SEA
"Endurance" trapped
Jan. 18, 1915
ANTARCTICA

The Shackleton expedition, 1914-1916

Crew trying to dig a passage for ***Endurance*** **(National Library of Australia - photo Frank Hurley).**

***Endurance*, a ghost ship in the long winter night of 1915 (Mitchell Library - photo Frank Hurley).**

Trapped in the ice

For the next month the crew watched helplessly as the *Endurance* drifted in the pack ice. Once clear water opened up about four hundred metres from the ship. The whole crew turned out with picks, chisels and saws, and tried to cut a path through the ice. But the temperature fell to minus 17°C, and the sea froze over as fast as they could cut it. *Endurance* lay only fifty kilometres from land, but the sea ice was so rough that no dog sledges could have crossed it. So Shackleton's land party could not get started. Nor could the ship get away, to make another attempt next summer.

On 24 February 1915, life on the *Endurance* changed. All the dogs were moved from the ship to igloos (nicknamed "dogloos") on the ice. The main hold was emptied of stores, and the twenty-six men set up new living quarters there. All the crew were taken off their normal ship's duties. They now took turns at the night watch. Their jobs were to keep the fire stoked, and to watch the ice and the weather. Officially, the *Endurance* was no longer a ship. From now on it was regarded as a shore station.

Over the next two hundred and eighty one days the *Endurance* was carried by the ice on a zig-zag course through the Weddell Sea. Moving eight kilometres a day, it was dragged in a great arc of about two thousand four hundred kilometres, ending up about nine hundred kilometres northwest of where it was first trapped.

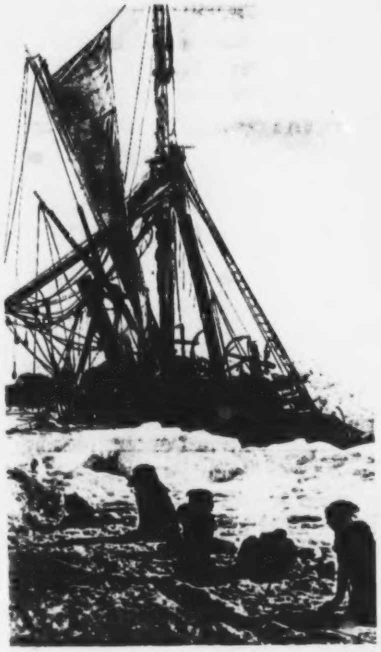
The crew worked at their scientific research. They looked after the dogs, and trained them to run in teams. The dogs were divided into six teams of nine. They were clipped in pairs to the main trace, with the lead dog running by himself. The driver carried a long-lashed whip, and told his team what to do:

Ready! - Stand
Mush! - Go
Ha! - Turn right
Gee! - Turn left
Whoa! - Stop

The dogs had three main types of foods. On the first day, they ate half a kilogram of seal meat and a quarter of a kilogram of blubber. On day two they got three quarters of a kilogram of dog biscuits, and on day three half a kilogram of pemmican (dried meat mixed with fat). Then they went back to day one.

Endurance **frozen fast in the pack ice, January 1915 (Mitchell Library - photo Frank Hurley).**

Captain Wild takes a last look at the twisted wreckage of *Endurance*. Soon it would slip beneath the water of the Weddell Sea (National Library of Australia - photo Frank Hurley).



The ship is slowly buckled and crushed by the pressure of the ice (Mitchell Library - photo Frank Hurley).

But there was not enough to do, and life on board became more and more boring. Ice had to be chipped from the ship's sides and propeller. Blocks of ice were needed on board for melting into water. The men amused themselves by playing football and hockey and on Midwinter Day had a feast followed by a concert. All this time, Shackleton and his crew were aware of the dangers. The wind howling in the rigging and the creak and groan of the moving ice were constant reminders.

On 26 July 1915, the sun peeped over the horizon for a minute then went down again. It was the first sunlight they had had for seventy-nine days. It was also the start of the breakup of the ice sheet that trapped the *Endurance*. The winds were blowing the ice north. It was breaking into icebergs, and drifting off to melt in warmer waters. The ice was moved by winds and currents. Sheets of ice would grind together, and build up hills of ice called pressure ridges.

Endurance destroyed

The moving ice played with the *Endurance*. The ship would be set free in clear water for a moment, then gripped between two ice floes closing together. It was squeezed and lifted, and tilted over on one side. The decks buckled under the strain, windows splintered, and the ship started to leak badly. The groaning and creaking of the timbers mixed with the pounding and scrunching of the ice against the side of the ship.

For ten weeks the *Endurance* was in terrible danger of being crushed. By late October the three ship's boats were loaded with emergency supplies and hauled across the ice to safety three hundred metres away. Pressure ridges of ice moved towards her from two sides. On 27 October, the carpenter reported to Shackleton that water was gaining on the pumps. The ship's hull had been bent twenty-five centimetres and ice had forced its way through the sides. The ship was doomed.

That day, nine months after it first became trapped in the ice, the *Endurance* was abandoned. Shackleton decided to head across the frozen sea to Paulet Island, five hundred and fifty kilometres away. They would have to take the boats with them, in case the ice broke up.

Shackleton's orders for the march were:

A path-finding party of three will start at 7.00a.m. with a light sledge, and demolish hummocks, bridge cracks, and smooth out the track. This party has a couple of hours lead on the main body. Then follow seven sledges, each drawn by seven dogs and with an average load of one hundred pounds (forty-five kilograms) per dog. Five teams to return and bring up the balance of the gear loaded on five sledges. The remaining two teams will link together and bring up the light boat. The balance of the party, eighteen members, will man-haul the large boat, the James Caird.

The march was abandoned after the party had travelled just sixteen kilometres in four days. It would have taken them more than a year to reach the island, because the going was so difficult. So Shackleton chose the most solid ice floe he could find. He built a camp, six kilometres from the wreck, and salvaged what he could. Then Shackleton and his twenty-seven men settled down to wait on the drifting ice.

Adrift on the ice

Shackleton planned to stay on the ice floe until it started to break up in the open sea. Then the crew would take to the three boats and try to row and sail to safety.

At first, life at the camp was tolerable. Then the floe started to melt and break up, and the weather turned worse. They could not leave their tents, and they all became very weak. The dogs had to be shot, because there were not enough seals to feed them. The dogs ate one seal a day.

Twenty penguins would last the party a day. Legs would be made into hoosh and breasts were cut into steaks. Livers and hearts were delicacies, and the skin was used as fuel for the stove. A seal would last five days, as food and fuel. Once a huge sea-leopard was killed, and in its stomach fifty fish were found in excellent condition. Drinking water was melted from ridges of the ice floe. This frozen sea water was salt free.

The main topic of conversation was the weather. Was the ice floe being blown out to open sea and escape? Every four hours the meteorologist gave Shackleton a weather forecast. Every day at noon their position was worked out with both sextant and theodolite.

As the floe headed out towards the open sea, it started to break up. Great cracks split across it, and the ocean swell started to move the ice up and down. The camp was moved to a safer spot. Shackleton hauled one of the crew from the sea after an ice crack went right through the tent where he lay asleep. Then a lead opened up in the ice. It was time to take to the water.

Adelie penguins croak a duet to a gramophone record (National Library of Australia - photo Frank Hurley).

Australian photographer Frank Hurley lived through the terrible ordeal and recorded it in some of his finest pictures (National Library of Australia).

"Ocean Camp" on the drifting sea ice, the expedition's home for nearly six months (Mitchell Library - photo Frank Hurley).

Shackleton (right) and Hurley in front of the blubber stove at the camp (Mitchell Library).

Adjusting a sledge (Mitchell Library - photo Frank Hurley).

Elephant Island

On 9 April 1916, just after lunch, the men slid the boats over a two metre ice cliff into the sea. The stores were hurled in, and they rowed through the narrow gap out towards an open stretch of blue water. They had lived on the ice floe one hundred and fifty-nine days. It was four hundred and forty days since the *Endurance* had first become trapped in the ice.

Now began a desperate race to reach land. Strong currents, gale force winds and heavy sea swells tossed the boats about. The men huddled in misery, wet and shivering. In freezing night temperatures they could not get enough rowing to keep them warm. They were frostbitten and hungry. The rough seas broke over the boat, and ice formed wherever the water landed. Some of the men suffered from sea sickness. All of them were thirsty, for they were now out of the icepack. Captain Worsley froze at the helm, and had to be massaged before he could move.

Six days later, on 15 April, they reached Elephant Island. It was the first land they had been on for seventeen months. "We were a pitiful sight; the greater number of us were terribly frost-bitten and half delirious. Some staggered aimlessly about, flinging themselves down on the beach, hugging the rocks, and letting the pebbles trickle through their fingers as though they were nuggets of gold."

The party was in a terrible position. The men were camping at a point they named Cape Wild, "a spit of rock thrust out into the sea, with a sheer ice-cliff on the land side, and a cluster of boulders just off its tip." To stay there meant death from slow starvation or exposure. Shackleton made his decision. He would take the best boat and the best five sailors and head across the world's wildest ocean aiming for the whaling station on the island of South Georgia.

The *James Caird* was chosen as the best boat. The carpenter strengthened and improved it. The boat was decked in, fitted with an extra mast, and loaded with a ton of ballast. On 24 April 1916, it was launched on the 1,200 kilometre journey. Shackleton left twenty-two men living in two upturned boats on Elephant Island to await rescue.

Members of the party left behind at Elephant Island (Mitchell Library - photo Frank Hurley).

The terrible journey

The *James Caird* did not sail well. It was slow and jerky and let too much water on board. After the third day only two things on board were dry – the sealed tins of matches and sugar.

The men split into two shifts of four hours each. Three of them tried to sleep in sodden sleeping bags, with water pouring in over them from the heavy seas. The three men on watch steered, pumped water out of the boat, and set the sails. Shackleton served hot milk every four hours, to fight the cold. Apart from that, they ate hoosh, nut-food, biscuits and lumps of sugar.

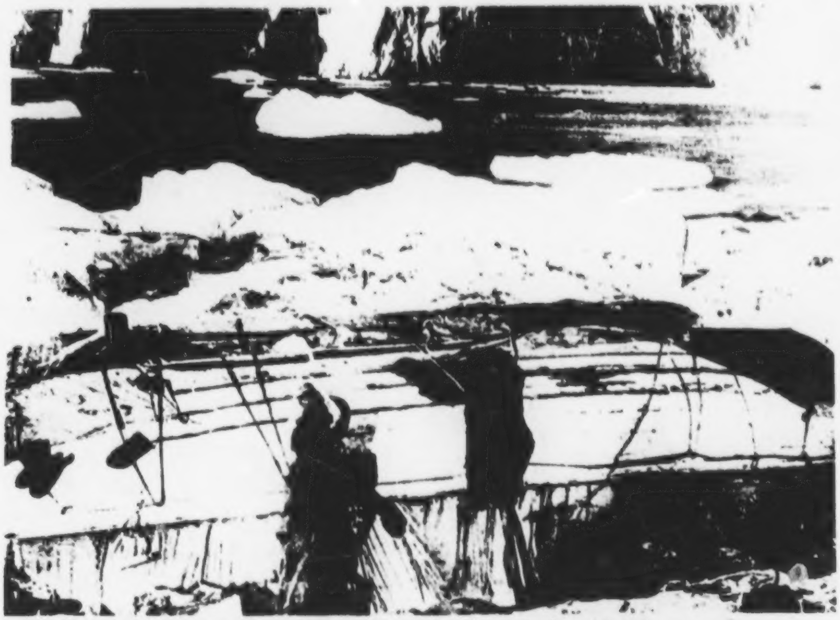
By the seventh day, the boat was coated with ice nearly forty centimetres thick. The *James Caird* was sitting low in the water and in danger of overturning. The ice had to be chipped off with an axe. The men worked for five minutes a turn, with icy seas washing over them.

On the ninth day a gigantic wave struck the boat. Shackleton was at the tiller, and he noticed a white line to the south-west. He thought that the clouds were lifting, and that he had seen a line of clear sky. A moment later he realised it was the crest of a giant wave. "We felt our boat lifted and flung forward like a cork in breaking surf. We were in a seething chaos of tortured waters; but somehow the boat lived through it, half full of water...".

Fourteen days after leaving Elephant Island they saw South Georgia. But their troubles were not over. A hurricane struck, one of the worst they had ever known. The seas tried to smash them against the cliffs of the island. For nine hours the *James Caird* clawed desperately away: "She gathered way, then crash! She struck an onrushing sea that swept her fore and aft ... While all baled and pumped for dear life, she seemed to stop, then again charged a galloping wall of water, slam! like striking a stone wall with such force that the bow planks opened and lines of water spurted in from every seam, as she halted, trembling, then leaped forward again."

The following day, 10 May 1916, they beached on the south-west coast of South Georgia island.

The whaling station was at Stromness Bay on the other side of the island. In a straight line it was thirty-five kilometres but the island was a mountain chain rising to three thousand metres.



"The Snuggery": two upturned boats laid side by side – dark, cold and cramped (National Library of Australia – photo Frank Hurley).

The ice was too rough for dog sledges and the distance to land too great for men alone (Mitchell Library – photo Frank Hurley).

Its rugged slopes were covered with sheets of snow and ice hundreds of metres thick. Shackleton could see that the glaciers, crevasses, and icy slopes would not be easy going. No one had ever crossed the island before. But he had no choice – two of his crew members were completely worn out. They had no hope of sailing round to the other side.

The whole group rested for four days. Shackleton, Worsley and Crean were to make the climb. The carpenter fixed sixteen brass screws into the soles of their boots to give them a better grip in the ice. These screws would be worn completely flat before the climb was over. The men carried food for three days, a primus stove, thirty metres of rope, a compass and binoculars. They set off at two on the morning of 19 May.

The day was perfect, and at the beginning they made good progress. But by mid-afternoon they lost their way in a maze of valleys and precipices. The snow was soft, and the going hard. Every twenty minutes Shackleton called for a two-minute rest, and the three of them would collapse on their backs in the snow.

Thirty-six hours after setting off they walked into the whaling station. They were filthy and smelled foul. Their clothes were in rags, and their long hair and beards were matted with soot and blubber. They had not had a bath or changed their clothes in seven months.

At first, no-one recognised them or believed them. Two young workers ran away in fright. They walked into the manager's office. One of the whalers tells what happened:"We did not know three terrible-looking bearded men who walk into the office off the mountainside. Manager say, 'Who the hell are you?', and terrible bearded man in the centre of the three say very quietly, 'My name is Shackleton'. Me – I turn away and weep."

Rescue

Within forty-eight hours the other three men from the *James Caird* had been picked up. It took three months and four attempts before a ship could get through the ice to Elephant Island to rescue the other twenty-two. Finally the *Yelcho*, a Chilean naval vessel, made its way through the ice and fog. Shackleton peered through his binoculars as they neared the island. He was counting the men standing on the shore. Then in relief he called to Captain Worsley, "They're all there, Skipper! They are all safe!".

Shackleton's expedition had failed. He had not even started on his attempt to cross the Antarctic from one side to the other. Perhaps it was just as well – it would have been a very difficult journey. The party of Vivian Fuchs and Edmund Hillary was the first to do it, in the Commonwealth Trans-Antarctic expedition of 1955-58. They travelled in tractors, with the assistance of radio and aircraft, and still had problems.

But even though he did not succeed, in many ways it was Shackleton's biggest triumph. He led his men through incredible dangers

◀

Saved! The final rescue, 20 August 1916
(National Library of Australia – photo Frank Hurley)

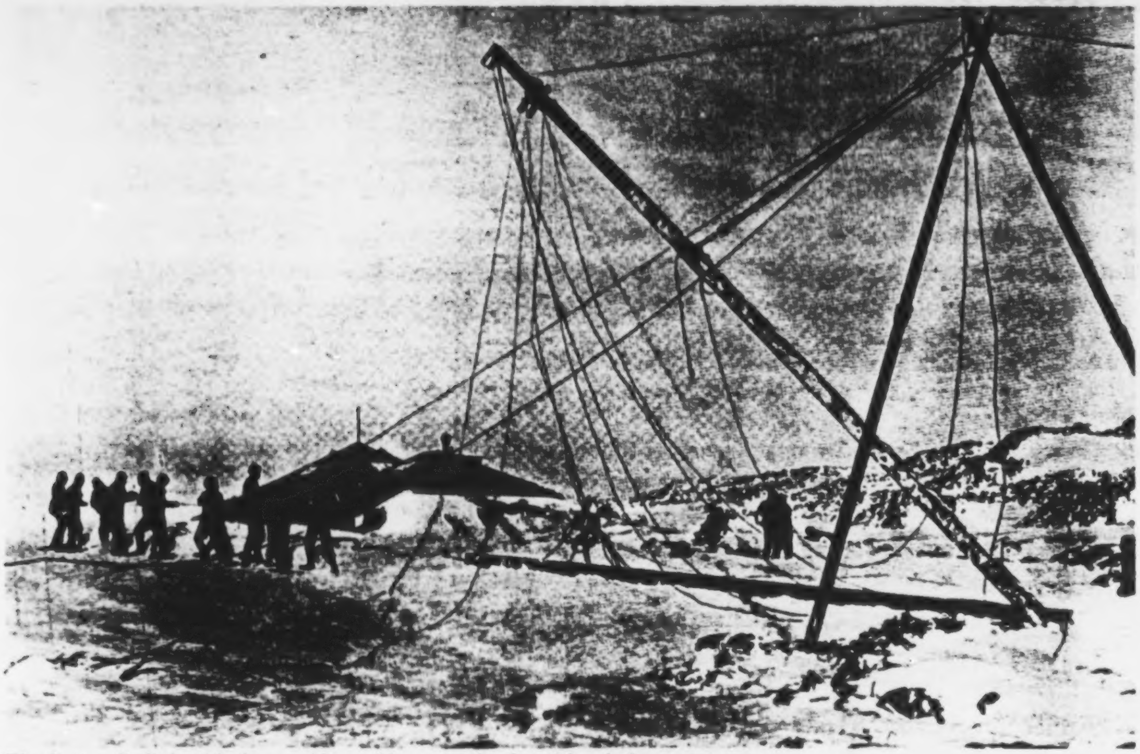
▶

and hardships. Not one of them died, although sometimes it seemed that no-one could hope to live. His leadership held the party together and gave it hope from 18 January 1915 when the *Endurance* was trapped in the ice until 20 August 1916, the date of the final rescue.

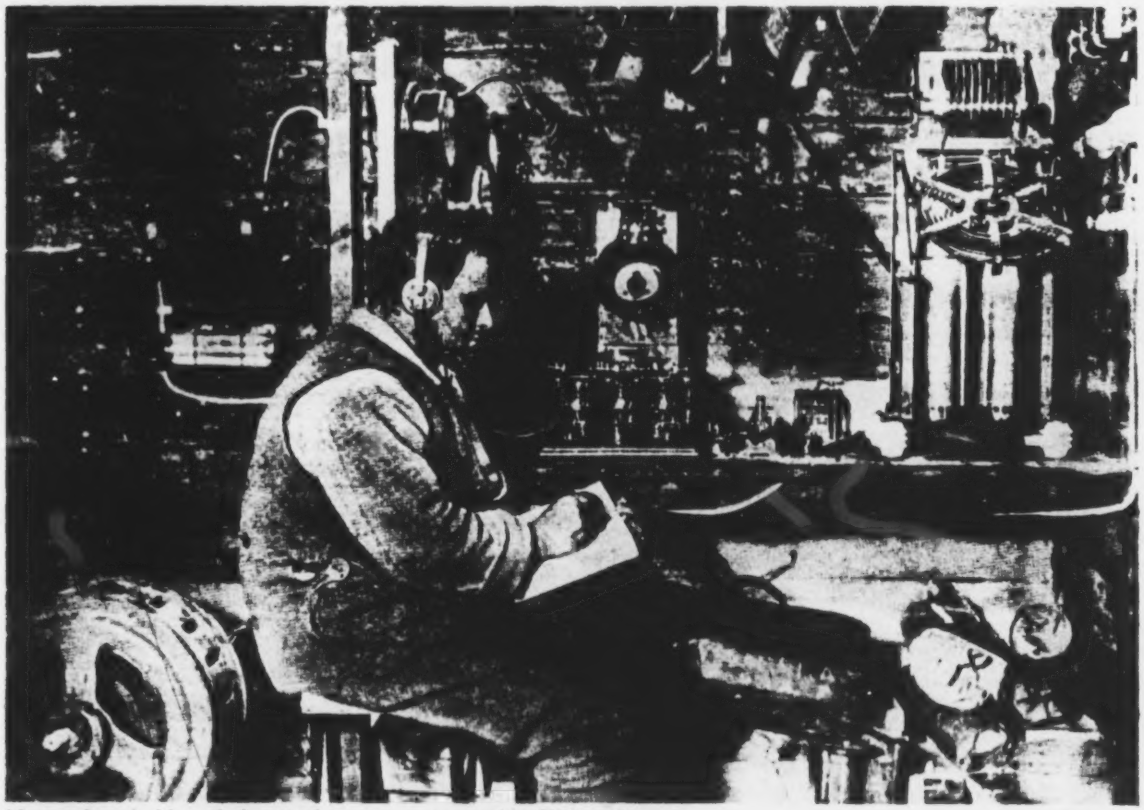
This was Shackleton's third trip to explore the Antarctic. At the beginning of his next expedition in 1922, he died of a heart attack and was buried on South Georgia.

Activities

1. What do you think would have happened if:
   - the *Endurance* had not been crushed;
   - the dogs had not been shot;
   - the expedition party had been able to reach land as originally planned?
2. On a map of Antartica, draw the routes of Scott and Amundsen, and the intended route of Shackleton. Now mark in where he actually went.
3. What do these words mean?
   - dogloo
   - pemmican
   - pressure ridge
   - hoosh
4. List all the foods that the crew of the *Endurance* ate.
5. Creative writing
   - a) Describe Shackleton's first bath for seven months.
   - b) As ship's carpenter, you are responsible for the maintenance of the *Endurance*. Make a record of damage done by the crushing ice. (Use accounts in earlier chapters of this book as well.)
   - c) You are a member of the expedition. Describe the landing on Elephant Island. How did you feel? Say how the camp was organised.
   - d) Shackleton was a born leader and his men had great faith in him. Write his private diary over one of the periods of crisis. You should record the daily events, his plans, and his personal thoughts.
   - e) Read Shackleton's orders for the march. Now make up his orders for the group he left behind on Elephant Island.



The first radio link with the outside world was made after this wireless mast was erected at Commonwealth Bay, 25 September 1912 (Antarctic Division, Australia).



Mawson's primitive wireless equipment was operated by Walter Hannam (Antarctic Division, Australia).

Chapter 9

Mawson: the scientist-explorer

Douglas Mawson, about 28 years old. (Antarctic Division, Australia).

The Australian claim of 6,500,000 square kilometres of Antarctica is larger than that of any other country in the Antarctic Treaty. This claim results largely from the work of one man, Douglas Mawson, the enormously energetic Australian scientist, explorer and administrator. He led some of the most important and fruitful early scientific expeditions to Antarctica; he survived a one hundred and sixty kilometre forced march through the ice by himself; and he went to the Antarctic four times. Yet he has always been overshadowed by more popular or tragic figures such as Shackleton and Scott.

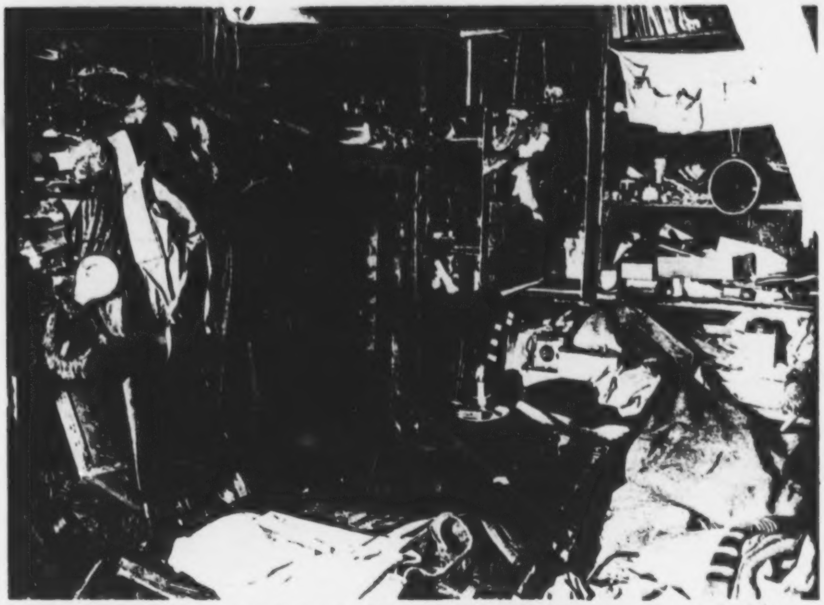
Early days

Mawson went to the Antarctic first with Shackleton in 1907. He stayed there for a year and was inspired by Shackleton's enthusiasm. That year was to serve as an Antarctic explorer's apprenticeship. Shackleton was trying to establish how to travel over ice, and what sort of ship was best suited to Antarctic waters. Mawson was able to profit by Shackleton's experience and learn from his mistakes.

Mawson soon showed his skill in the field. Accompanied by Professor David and Dr Mackay, he hauled a sledge two thousand kilometres from Shackleton's winter depot at McMurdo Sound to the South Magnetic Pole and back. It took one hundred and twenty two days for the three men to haul their sledges - without the help of dogs or machines - over this distance. The same three men, with another party, had earlier climbed the four thousand metre volcano Mt Erebus. When they reached the top, they found a column of steam pouring out three hundred metres into the sky, and molten lava bubbling in the crater.

Mawson's group about to climb the volcano Mt. Erebus, December 1908 (Antarctic Division, Australia).

Mackay, David and Mawson stand at the South Magnetic Pole in January 1909
(Antarctic Division, Australia).



Mawson went to Antarctica first with Shackleton in 1907. His room, cluttered with gear and scientific instruments, was dubbed the "Pawn Shop"(Antarctic Division, Australia).

Mawson became fascinated by the Antarctic. He wanted to explore and discover everything he could. Shackleton describes Mawson's bunk in the hut as being covered in an "assortment of cameras, spectroscopes, thermometers, microscopes, electrometers and the like". Notebooks and instruments were crammed into home-made shelves on the walls. Shackleton says the room was called "the Pawn Shop".

Mawson visited England after this expedition returned. There he met Scott, who pressed him to join his expedition of the following year. Scott offered him a salary and a place in the party to go to the South Pole, but Mawson declined. The race to the Pole did not interest him. He wanted to uncover the secrets of the Antarctic by exploration and research. He particularly wanted to revisit the area around the South Magnetic Pole and to explore the country to the west.

Mawson's Magnetograph Hut at Cape Denison: (a) interior, (b) exterior, (c) recent photograph (Antarctic Division, Australia).

An Australasian expedition

Mawson decided to organise an expedition of Australians and New Zealanders to explore those areas of the Antarctic directly to the south of Australia. He toured Australia and Britain, trying to interest groups in giving his expedition money to buy stores, equipment - and a ship. It was difficult, because governments were short of funds. The ship had to be strong, and have sails as well as an engine in case they ran short of fuel or damaged the propeller. Mawson settled for the *Aurora*, a sealer fifty metres long, nine metres wide and able to carry six hundred tonnes. Captain John Davis, who had chosen her, was in command. They set out from Hobart on 2 December 1911. Mawson planned to take a year exploring three thousand kilometres of unknown coastline, by land and sea. Davis was to drop off four land parties, one at Macquarie Island and three more on the unknown coast. The first party was set down on Macquarie Island, to put up a wireless relay station, and *Aurora* continued south.

In January 1912 the main party was landed at Commonwealth Bay, and *Aurora* struggled westward to put a smaller group ashore on the Shackleton Ice Shelf. The explorers quickly discovered that Commonwealth Bay was the windiest place in the world. "Day after day the wind fluctuated between a gale and a hurricane." Walking was impossible at

John King Davis has been called 'the greatest of modern Antarctic navigators'. He was captain of Shackleton's *Nimrod* and later of *Aurora* and *Discovery* under Mawson (Mitchell Library).

first. They had to put crampons on their boots. In the worst gales they had to lean over into the wind at an angle of forty-five degrees.

The Antarctic is the windiest continent in the world. A later Australian expeditioner, John Béchervaise, recalled watching as two Beaver aircraft were blown to bits before his eyes. The aircraft had been securely tied down and fitted with "wind-spoilers", but the wind gusted to over three hundred kilometres an hour! The wings and tailplanes were ripped off, then the aircraft were torn to bits. In these winds it is hard to stand up, let alone walk. The pressure of the wind against a person or building increases very quickly as the wind speed rises (see Appendix B).

Despite the bad weather, Mawson and his seventeen companions started their scientific work. A meteorological station was established to get an accurate picture of the weather. Two huts were built for the magnetographs, which measured the Earth's magnetic field. The biologist set fish traps in Boat Harbour and samples of bird life were caught for the collection.

A wireless mast was erected and on 25 September 1912 the first message ever to be sent from the Antarctic was heard in Australia: "Please inform Pennant Hills ...". There was nothing more until four days later, then: "Having a hell of a time waiting for calm weather, put up masts." The aurora australis, the southern lights which lit up the night sky, were observed and recorded. Shafts were dug in the ice to see whether the temperature and ice structure changed, and tides were measured.

While all this scientific work was continuing, preparations for the next summer's sledging trips were made. Canvas harnesses for dogs and men were individually measured and sewn on the big sewing machine. Sledging rations were measured out. High-energy foods were carefully chosen, because the sledge loads had to be kept as light as possible. The eighteen members of the party were divided into six sledging groups. Each was to go off in a different direction from Commonwealth Bay. Their main aim was to map the coastline.

Mawson's route 1912-1914

TH AFRICA
ANTARCTICA
Shackleto
2
RALIA

Mawson's party

On 17 November Mawson set off with Belgrave Ninnis and Xavier Mertz. They were to explore the coast to the east of the main base. Their total load was one thousand one hundred kilograms, shared among three dog-teams and sledges.

640kg	*dog food*
216kg	*human food*
87kg	*three sledges, straps and storage boxes*
29kg	*clothes*
28kg	*pack, spade, ice axe, rope, crampons, ski boots*
27kg	*kerosene, stove, fuel*
20kg	*tent*
14kg	*three sleeping bags*
12kg	*surveying gear and other instruments*
11kg	*cooker, mugs, primus heater*
10kg	*beacons and flags*
4kg	*medical supplies (including scalpel, forceps and bandages) tools, and repair outfits*
4kg	*camera and film*
2kg	*rifle, ammunition and knife*

Bage, a member of Mawson's expedition, prepares hoosh in Aladdin's Grotto, an ice cave where they had a food dump (National Library of Australia – photo Frank Hurley).

Mawson, Ninnis and Mertz made quite good progess with their dog-teams, although blizzards sometimes kept them in their tents. Antarctic winds are frequent and strong. At thirty kilometres an hour they pick up drift snow and the air becomes a whirling white mass. Visibility drops to near zero. As the wind speeds rise, the snow is blown along faster and harder, until the snow and ice crystals are shot along like iced bullets.

Travelling in these conditions is impossible. An explorer in the middle of a journey must take shelter until the wind drops. As blizzards can last for days, food supplies may run short. The snow and ice are blown along with such force that they polish rough metal to a bright sheen and scour away the edges of wooden signposts.

The explorers were also slowed by small ice ridges called sastrugi, and the danger of falling into crevasses covered by snow-bridges was constant. All of them suffered from snowblindness, caused by the sunlight reflecting off the ice into their eyes.

Belgrave Ninnis went with Mawson and Mertz on their ill-fated expedition in the summer of 1912 (Antarctic Division, Australia).

Disaster - and endurance

The fourteenth of December was a fine, sunny day with a light breeze. The temperature was a mild minus 6ºC. Ninnis, Mertz and Mawson were in a good mood as they made plans for a final dash eastwards before starting the journey back. Mertz was skiing in the lead, with Mawson following and Ninnis bringing up the rear.

Suddenly, Ninnis and his dog-team disappeared. Mawson turned around to see an empty white landscape. He hurried back and found "a gaping hole in the surface about eleven feet wide". The snow-bridge over a crevasse had caved in under the weight of Ninnis and his team, the same bridge that Mertz and Mawson had just crossed without incident. Mawson peered over the edge.

"I leaned over and shouted into the dark depths below. No sound came back but the moaning of a dog, caught on a shelf just visible a hundred and fifty feet below ... Another dog lay motionless at its side. Close by was what appeared in the gloom to be the remains of the tent and canvas food-tank containing a fortnight's supply".

Of Ninnis there was no sign. They did not have enough rope to climb down into the crevasse, but called into it for three hours. Mawson

Mawson's party scrambling amongst splintered ice on the way to the plateau (courtesy P.M. Thomas - photo Frank Hurley).

"The wind is so strong that men have to lean into it to walk."
(courtesy P.M. Thomas - photo Frank Hurley).

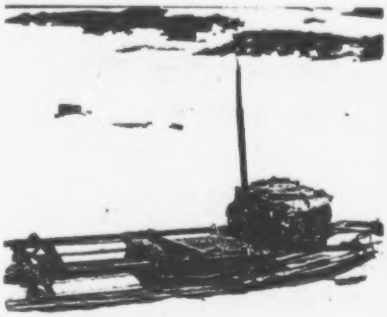
Mertz in an icy ravine, Adelie Land
(National Library of Australia
- photo Frank Hurley)

and Mertz were in a desperate position. Most of the food had been on Ninnis's sledge. So were the tent, spade, ice-axe, mugs and all the dog food. They had only ten days' food supply and six very weak and miserable huskies; and they were five hundred kilometres from the hut at Commonwealth Bay.

The two of them carefully sorted through the remaining gear. For dinner they had a thin soup made from boiling the empty food bags. The dogs were given worn-out reindeer skin boots and mitts and some "spare rawhide straps, all of which they devoured". Then the explorers harnessed the dogs and set off on a mad dash across dangerously crevassed country to where they had camped three days before. A broken sledge had been abandoned at this camp and they could use it to make a tent frame.

The next day the first dog was killed to provide food. Mawson and Mertz found the meat tough and stringy, with a horrible taste. The liver was better. It could at least be easily chewed. But the liver held a dangerous secret.

For his desperate lone journey back to safety Mawson used a pocket knife to cut his sledge in half to lighten it (National Library of Australia - photo Frank Hurley).



The fight for survival

For twenty-three more days they struggled painfully towards the hut. Their progress was slowed by strong winds and poor travelling surfaces. The dogs had all been killed. The men were always hungry and their poor diet caused headaches and vomiting. The skin peeled off their bodies. They lost weight.

Mertz felt the dog meat was not doing him much good. He became gloomy and depressed and grew very weak. Mawson had to feed him and help him to dress. He tried to drag him along on the sledge. But Mertz grew worse, and he took a fit in which he bit off his little finger. The next day he was dead.

The cause of Mertz's death is now believed to have been in the dogs' liver he had eaten. But this was not fully understood until 1971. The problem began with the huskies' diet, which included seal meat. Seals build up massive amounts of vitamin A in their livers. If huskies eat seal livers, their livers also become rich in Vitamin A. This is not poisonous to humans unless they eat very large quantities. Mawson and Mertz, completely unaware of the danger, ate enough to cause serious trouble. They thought their problems were caused by hunger and scurvy.

Mawson buried Mertz beneath a snow cairn. Then he cut the sledge in half to lighten it, made a sail out of Mertz's waterproof clothing and set off for Cape Denison, a hundred and sixty kilometres away.

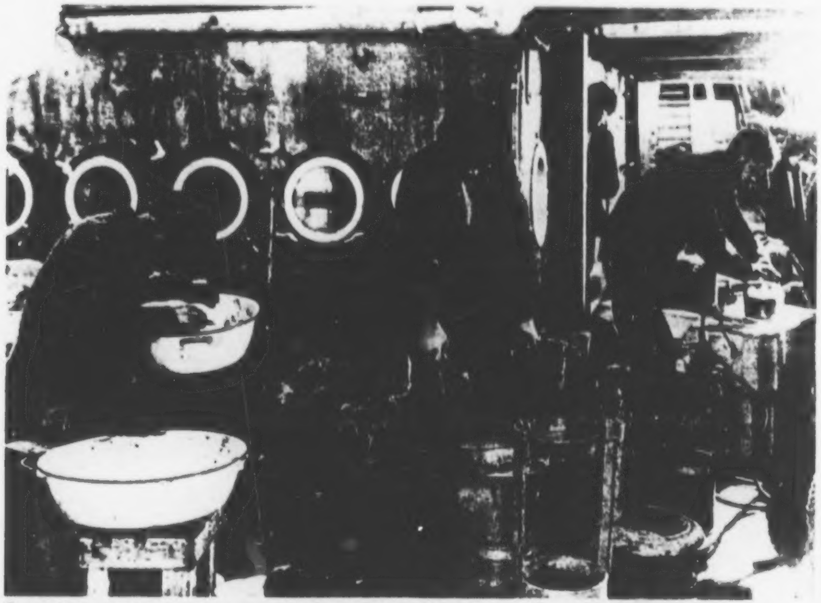
From the start his feet felt "curiously lumpy and sore". When he took off his socks to examine them, Mawson was shocked to see that the sole of his foot had come away in a single layer. He smeared lanolin over his raw and bloody feet and bound the soles back on with bandages. "Over the bandages were slipped six pairs of thick woollen socks, then fur boots, and finally crampon overshoes".

Mawson struggled on, fighting bad weather and difficult walking surfaces. His feet were getting worse rather than better. Nearly stupified with exhaustion, he fell into a crevasse and found himself dangling on the end of the sledge rope. It took all his effort to clamber up five metres to the surface. Then, as he was hauling himself out, the edge of the crevasse gave way and again Mawson found himself dangling in the icy chasm. The prospect of a fall to certain death appeared as a relief. But he refused to give up. The effort of getting out a second time was almost too much. He collapsed by the side of his sledge and lay there unconscious for an hour or two.

Twenty-three days after Mertz had died, Mawson had a change of luck. He found a snow cairn made by a search party. It contained a bag of food, and news that Amundsen's party had reached the Pole. Aladdin's Cave, their sole depot, was only thirty-five kilometres away and the main hut a further eight kilometres beyond that.

When he finally walked down the steep icy slope into Commonwealth Bay, Mawson must have been unrecognisable. His face was frostbitten, his weight had dropped by half, the hair from his face and head had moulted, and skin had peeled off all parts of his body. He had covered the last one hundred and sixty kilometres of this terrible journey alone. Mawson's body was shattered by this physical ordeal. "He had aged, was worn, had lost much of his hair, and I fear he was never again the same iron man who started on that fateful journey." This was how Eric Webb, one of his fellow explorers, described him a year later.

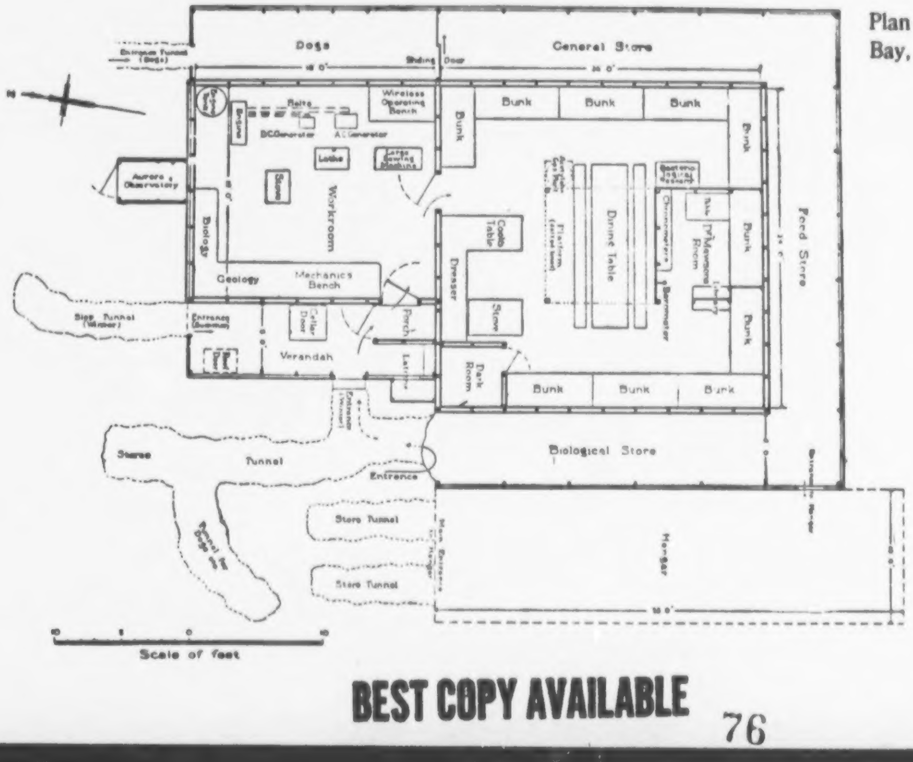
Xavier Mertz in summer rig, before his fatal journey (courtesy P.M. Thomas - photo Frank Hurley)



Scientists sorting specimens of marine life on board the *Discovery*, 1929-31 (courtesy P.M. Thomas - photo Frank Hurley).

Back at the hut after a sledge trip. Ice masks have formed from frozen water vapour from the breath (courtesy P.M. Thomas - photo Frank Hurley)

Scientists reading the "puffometer" had to hang on grimly to avoid being blown away. The instrument recorded maximum wind speeds (Antarctic Division, Australia).


Dogs
General Store
Sliding Door
Entrance Tunnel (Dogs)
18' 0"
Wireless Operating Bench
Bunk
Bunk
Bunk
Bunk
Bunk
Engine
Belts
DC Generator
AC Generator
Lathe
Large Sewing Machine
Aurora Observatory
Stove
Workroom
Biology
Geology
Mechanics Bench
Cook Table
Platform
Dining Table
Chronometers
Dr Mawson's Room
Table
Bacteriological Research
Barometer
Dresser
Food Store
Bunk
Bunk
Slop Tunnel (Winter)
Entrance (Summer)
Cellar Door
Porch
Stove
Verandah
Latrine
Dark Room
Bunk
Bunk
Bunk
Entrance (Winter)
Stores
Tunnel
Entrance
Biological Store
Store Tunnel
Store Tunnel
Main Entrance to Hangar
Hangar
Scale of feet
10
5
0
10

Plan of Mawson's hut at Commonwealth Bay, 1911-14 (Antarctic Division, Australia).

Mawson in London in 1914, still very thin after his terrible journey. Mawson (in flat cap) is pictured with Frank Wild, Shackleton and Davis (Antarctic Division, Australia).

Rich results

But the fascination of the Antarctic did not loosen its grip on Mawson's mind. He had brought back a flood of information for scientists to examine closely and he wanted to return for more. His teams had surveyed animal and fish life, examined ice structure and rocks, recorded the weather and the Southern Lights. They had undertaken two years of valuable exploration of unknown coasts, most of it in terrible weather. Parties from Commonwealth Bay ranged over four hundred kilometres to the east, two hundred and fifty kilometres west. They nearly reached the South Magnetic Pole five hundred kilometres inland.

The men put ashore on the Shackleton Ice Shelf wintered apart from the main group, and investigated over four hundred and eighty kilometres of difficult coastline. The *Aurora* had made observations along the coast between two bases, and taken many samples from the ocean floor. Traces of coal, copper and valuable minerals had been found. The expedition was the first to use both wireless and the air tractor (a wingless plane) in Antarctica. The president of the Royal Geographical Society welcomed Mawson to England with the words: "There has been no Antarctic expedition the results of which ... have been richer."

Mawson had great plans. He wanted Britain to claim the parts of Antarctica he had explored as an extension of the British Empire. He felt that it was vital to build up an accurate picture of the resources and wildlife of the continent. Mawson had seen the slaughter of whales and penguins for oil and other products and wanted to protect these animals.

Mawson had left Antarctica in 1914. It was at this time that war stopped most scientific work in Antarctica. From 1914 to 1918 all the major countries of the world were involved in conflict. World War I pushed to one side the dreams of scientists like Mawson.

It took Mawson fifteen years to persuade the Australian and British Governments to send another expedition. By 1929 interest in the southern continent had increased again. Scientists wanted more information to continue their studies. They had examined the notes and records collected by earlier expeditions. Now they wanted new research data to work on.

Mawson planting the British flag. He claimed large areas of Antarctica for Britain (Tasmanian Museum).

Australia was also worried about renewed activity by Norway. Whaling ships from that country were becoming more active in the Southern Ocean. Norway had begun to claim islands around the Antarctic for its ships to use as base stations. This could mean a rival nation in those parts of Antarctica in which Australia was particularly interested, the section Mawson had begun to explore twelve years before.

There was also a threat to the whales. Some types of seals had been completely wiped out by the sealers a hundred years before. Were whales to suffer the same fate?

A new expedition

In 1929, after a lot of hard work, Mawson got the backing necessary for a new expedition. Funds came from the Australian and New Zealand governments, and from private sponsors. The British government donated Scott's old ship, the *Discovery*. The Australian prime minister gave him orders to survey the coast and chart all the rocks, islands and shoals. "You will plant the British flag wherever you find it practicable to do so ... and carry out to the best of your ability all scientific work and investigations."

In October 1929 Mawson's British, Australian and New Zealand Antarctic Research Expedition (BANZARE) set out. For the next two summers he sailed along the coast of Antarctica, mapping, collecting and exploring. He landed at several points, and took possession of the newly discovered land in the name of King George V. The *Discovery* carried a Moth seaplane, which was launched every time the weather was good, so the explorers were able to view large areas without ever setting foot on them. They mapped the seabed with an echo-sounder.

Scientific information was collected steadily. The hydrologist took samples of sea water at various depths and measured sea temperatures. Fish and sea creatures were caught in fine mesh nets. When the nets were pulled up and the contents spilled on to the deck, all the scientists helped to sort and bottle specimens. The seabed was dredged to scrape up rock samples. Balloons were released to gain information about winds in the upper atmosphere. Biologists captured and skinned a collection of birds and animals.

Mawson felt his most important work was in proving that the Antarctic was a land mass covered with ice. He was able to show that the section of Antarctica to the south of Australia was one continuous stretch of land, by using an echo-sounder to build up a picture of the sea floor. Until then, it was still a possibility that Antarctica was a group of ice-covered islands.

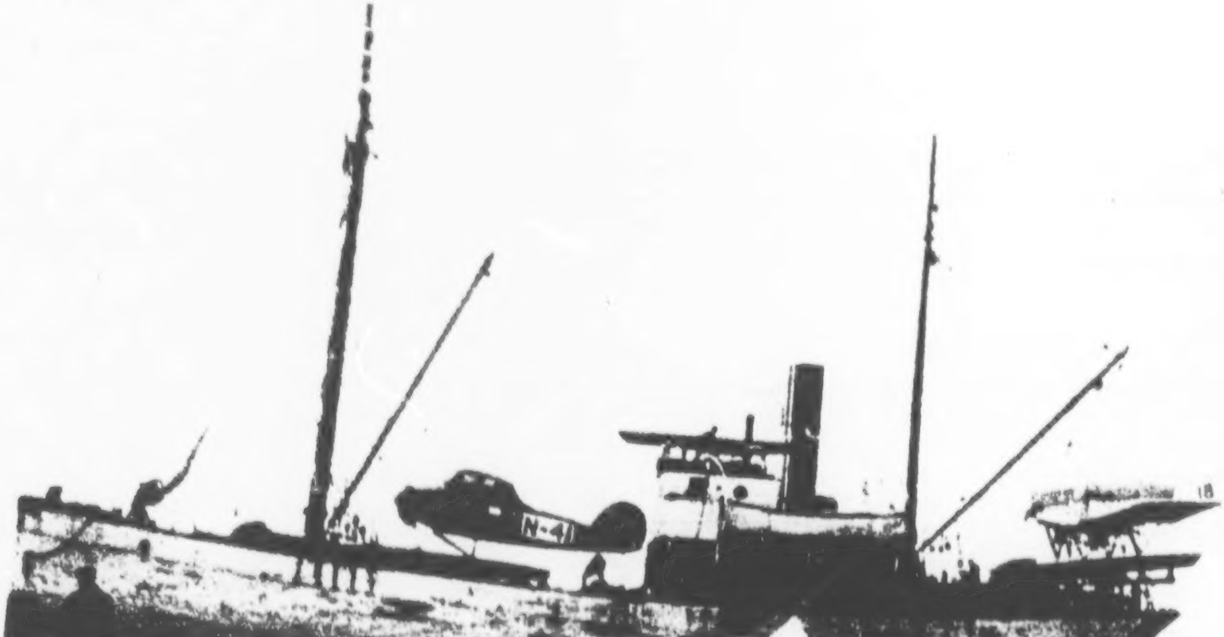
These voyages were different from the early explorers' journeys. There were no sledging trips, no forced marches, no huskies to eat, no crevasses to fall down. The party sailed south in October, spent the summer in Antarctic waters and returned to Australia in March for the long winter. They made the same trip the next year.

The life was hard, and sailing in the icy waters of Antarctica is always dangerous, but the ship was in constant radio contact with Australia. It was not as perilous as the earlier voyages of exploration. Mawson himself said the heroic age of exploration was over and the mechanical age had arrived. Aeroplanes had changed the nature of exploration forever.

In the same way, Mawson changed ideas about Antarctica forever. The two expeditions of 1929-30 and 1930-31 brought back enormous amounts of information. The coast he sailed along had been almost completely unknown, and he mapped parts of it. The knowledge Mawson brought back added much to the real scientific understanding of the Southern Ocean.

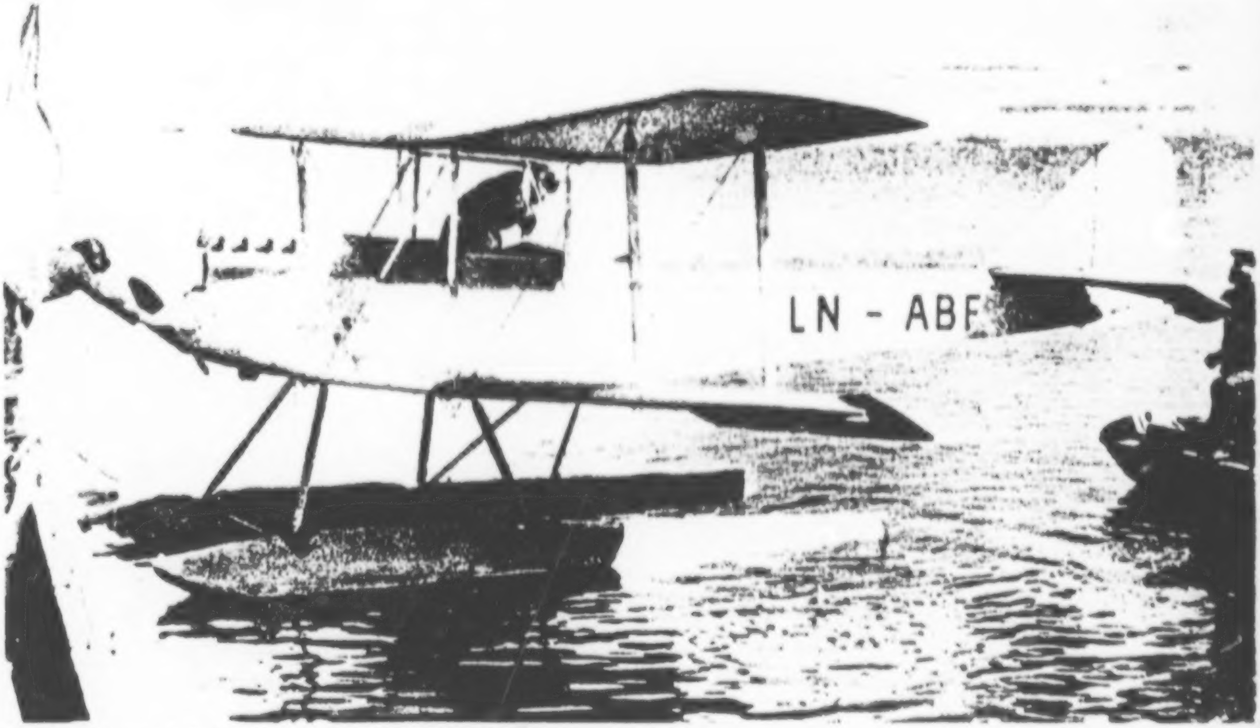
Mawson was concerned about the future of wildlife and wrote to his wife:

At the same time that we came into the bay (of Crozet Island) a sealing craft arrived and they stayed slaughtering the sea elephants – a terrible massacre – not one escaped. The bulls and cows were all killed, as well as the three-month-old babies, for their blubber. The very young calves were merely hit on the head and left. There must be some protective measures for these beasts else they will be extinguished very soon.



Activities

1. Make a list of the experiments and research work carried out by Mawson and his party.
2. Draw a diagram of a crevasse. How did Ninnis come to fall in?
3. Make up a wireless message, the first to be sent from Antarctica.
4. Explain Mawson's statement that the heroic age of exploration was over and the mechanical age had arrived.
5. Read again the list of supplies that Mawson took on his expedition from Commonwealth Bay. If the load had to be lightened, what would you leave behind?
6. Why didn't Mawson want to go on Scott's expedition?



Seaplanes began their important role in Antarctica (Crowther Collection).

Norwegian whalers became interested in Antarctic waters in the 1920s. The *Norvegia*, equipped for science as well as whaling, is shown caught in the ice (Crowther Collection).

A crewman "talks down" the pilot of a U.S. Navy Iroquois helicopter about to pick up a field party. (N.R. Kemp)

A New Zealand party sets out on skidoos. The bamboo poles on the Nansen sledges are for marking crevasses for the return trip. (N.R. Kemp)

Part 3

DICK SMITH EXP
LORER

A private expedition. The steel-hulled schooner *Dick Smith Explorer* winters over in the ice, 1983. Expedition member Mimi George clears a trench in the ice to correct the boat's list (National Geographic - photo Gill Cracknell).

Chapter 10

The modern era

Opening up a continent

There was still much to learn about Antarctica. The explorers of the "heroic era" had examined parts of the coastal areas which were easily reached, but the interior of the continent was still almost unknown. Most of the coastline was still unmapped. No one had ever wintered inland on the plateau, and weather conditions there had not been recorded.

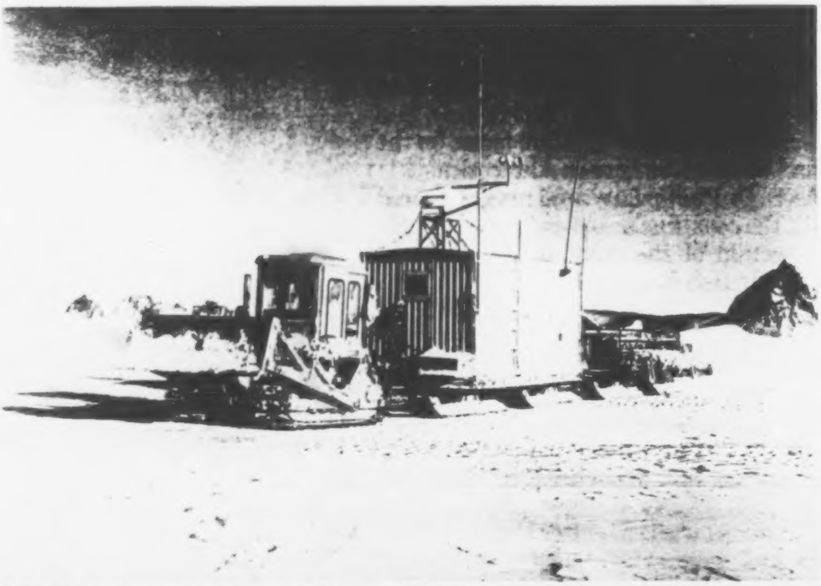
The heroic age had ended, and the methods of explorers changed dramatically. No longer did they rely on muscle to overcome the natural problems of Antarctica. They used machines - planes, helicopters, tractors and other snow vehicles, radar and echo-sounders. The problems that Cook, Nordenskjold, Amundsen and Shackleton faced are still present, but long experience and modern equipment help researchers avoid the dangers of crevasses, icebergs and snowblindness. The land has not been conquered, but modern machinery and modern understanding have made survival easier.

Air transport revolutionised exploration. Scott took four months to man-haul his sleds to the South Pole and died in the attempt. In 1929, the American Admiral Richard Byrd made the same trip in his Ford Trimotor plane in nineteen hours. Here was a method of exploring vast areas of unknown territory easily and safely. Just months before, Australia's Sir Hubert Wilkins had made the first plane flight in Antarctica.

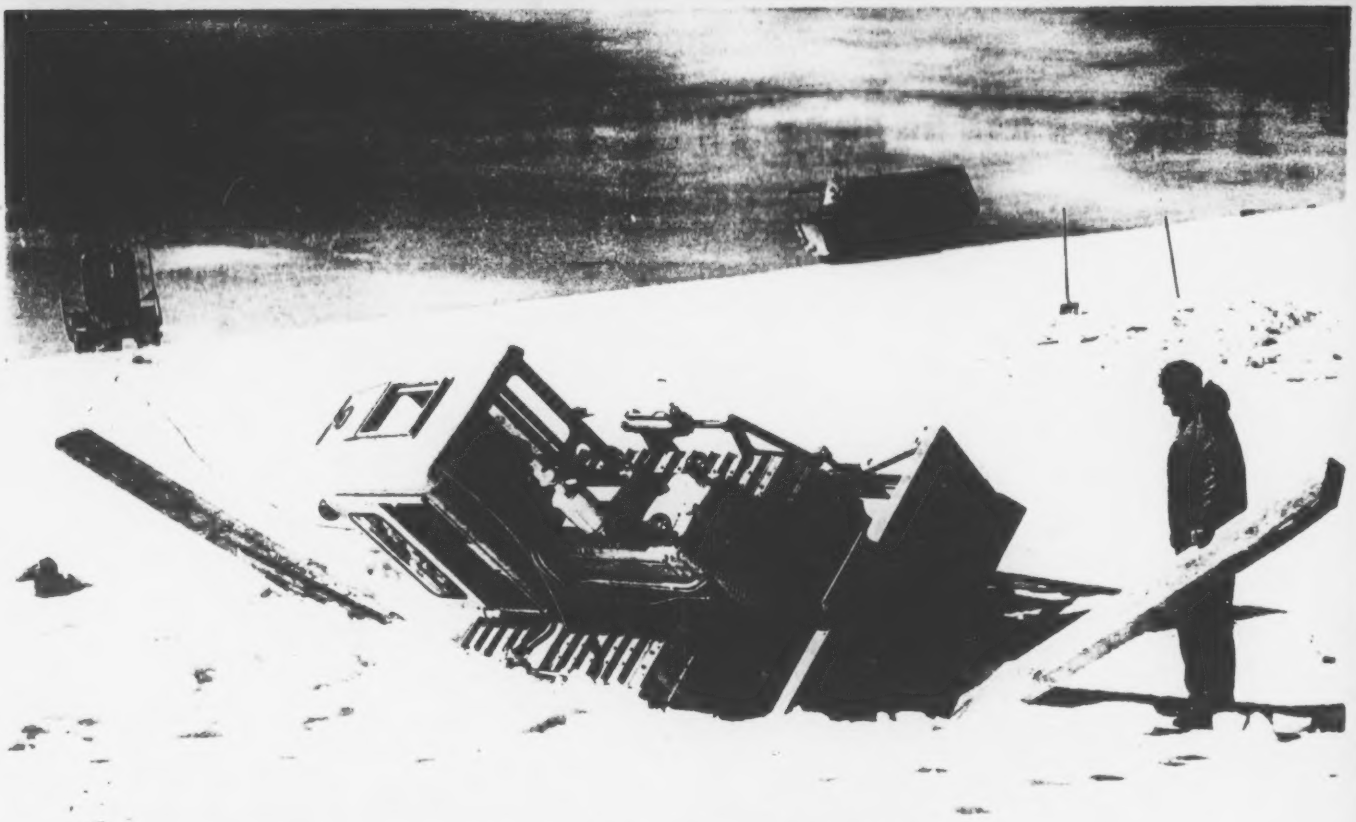
Byrd may not have been the first pilot in Antarctica, but he certainly brought the machine age to that continent. His expedition of 1933 introduced a whole new range of vehicles - two light snow-mobiles, three tracked Citroen trucks and a six-ton tractor. They brought four aircraft with them. The Kellett autogyro was the first helicopter in Antarctica.

Byrd led five successful expeditions to Antarctica. The American expeditions introduced more and more modern technology - most importantly radio equipment - to overcome the natural hazards of the icy wilderness. The days of heroic explorers organising their own expeditions

Rear Admiral Byrd, American aviator and expedition leader (Wide World Photos).



A tractor-train on the Antarctic Plateau. Scientists will live and work in the hut (Antarctic Division, Australia).



A bulldozer breaks through the ice of a meltwater pool. Note the emergency hatch in the cabin roof (Antarctic Division, Australia).

were coming to an end. There were no more desperate races through blizzards, no more adventurers spending the winter in huts designing and making the materials on which their followers' survival depended.

A new era of highly organised research had begun. It was interrupted from 1939 to 1945, during World War II. After the war, the governments stepped in. They organised large-scale scientific expeditions, highly professional groups which were to set up permanent bases in the Antarctic.

ANARE

In Australia, ANARE (Australian National Antarctic Research Expeditions) was set up. ANARE's first job was to establish a permanent base on the Antarctic continent. Australia had set up bases on both Heard and Macquarie Islands in 1948 but, except for a number of small bases on the Antarctic Peninsula, no country had bases elsewhere in Antarctica.

In 1955 the Director of ANARE, Dr Phillip Law, and his staff pored over maps and aerial photographs of the coastline searching for a suitable site. Mawson had sailed along a section of the coast to the south of Australia, and had claimed it for the British Empire. Parts of this coast had later been mapped by the Norwegians and photographed from the air by the Americans.

The Australians wanted a rocky site, which is rare in Antarctica because most of the ground is ice-covered. It had to provide an anchorage for ships, and be close to glaciers and mountains for the scientists. Law chose a rocky outcrop which surrounded a horse-shoe shaped harbour. The rocks would provide a good building site and sheltered water for mooring the ships.

The new station was built in February 1954, after the *Kista Dan* had pushed its way through the ice to anchor in the bay. Two Auster aeroplanes were unloaded, both damaged by a storm the previous night,

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and then the rest of the cargo was swung out of the hold onto the waiting cargo sledges. Weasel tractors towed the sledges across the sea ice towards land.

The sea ice rises and falls with the tide, as it is not frozen to the land. A further amphibious Weasel towed the sledges through the jumbled ice of the tide crack up onto the rocky shore. Unloading the ship was a major task. Prefabricated huts, scientific instruments, husky dogs, electric generators, fuel drums, food, and planes and tractors were carried on to the stark shoreline.

Scientific work started immediately. One plane was repaired and made a series of survey flights inland, and along the coast. Scientists began to collect samples, measure magnetic activity, and take meteorological observations.

Eleven days after the *Kista Dan* was moored in the bay, the buildings had been put up. They had been prefabricated in Australia, then taken apart for transportation to Antarctica. The huts were designed so they could be erected in one day, to avoid the danger of a half-completed building being blown away in the sudden storm that is so common in Antarctica.

Phillip Law compared it to building a house out of cards. First, a foundation of railway sleepers and wooden bearers was laid and tied down with steel cables. Then the floor sections were bolted on. The wall sections were raised, and fittings and furnishings put in. Finally the roof panels were clamped into place.

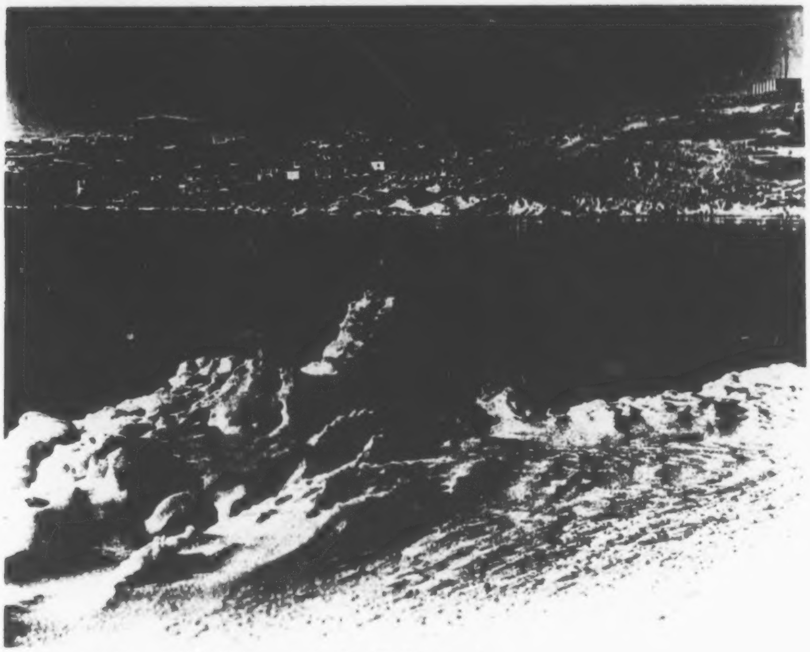
The new station was named Mawson in honour of the Australian explorer and scientist. Ten people were to remain there for the winter. The *Kista Dan* sailed eastwards to investigate some half-known features sighted by earlier explorers.

Mawson Station was the first large, permanent scientific base to be built on the Antarctic continent. It has been operating ever since. About thirty scientists, technicians and tradesmen live there each winter, with this number doubling in summer.

The base is five thousand two hundred kilometres south-south-west of Perth. There are separate huts for each activity - science laboratories, power houses, workshops, the hospital, store rooms, a photographic darkroom, a radio/communications room, and living quarters. There are huts for sleeping, cooking, eating and relaxing. They are scattered over a wide area so that a fire could not spread easily from one hut to the next.

A ski-doo motor toboggan, the "tin dog" of Antarctica (Antarctic Division, Australia).

Tracked vehicles and the lee side of buildings drifted-in after a blizzard (N.R. Kemp).



Summer at Australia's Mawson station (B. Sorensen).

Over the next fifteen years, the Australians under Phillip Law and his deputy Don Styles built two other bases, calling them Davis and Casey. Teams operating from these bases were to map nearly five thousand miles of coastline, and more than two and a half million square kilometres of uncharted territory. They discovered the largest glacier in the world, the Lambert Glacier.

New Zealand joins in

New Zealand has been the starting point of activities in the Antarctic region for the last two hundred years. Whalers, sealers, explorers and scientists have used the country as a base from which to launch expeditions into the Southern Ocean and Antarctica. New Zealanders have joined many of these expeditions.

Since 1923, New Zealand has claimed sovereignty in the area of Antarctica immediately to its south, around the Ross Sea. A base for research and exploration was established at Pram Point on Ross Island in 1957. This site had earlier been used by Scott and Shackleton, and other explorers of the heroic age. It was named Scott Base.

Pram Point was chosen by Sir Edmund Hillary, the man who four years earlier had been in the first party to climb Mount Everest. It was to be the finishing point for the first expeditionary group to cross Antarctica from one side to the other, going through the South Pole on the way.

Scott Base has been kept going as a scientific base since then. New Zealand also maintains summer bases and huts at other points on Ross Island and nearby sections of the mainland.

A new world

The first scientific groups who came to the Antarctic after World War II had only a limited knowledge of the continent. "There were many stretches of the coast that had never been explored and many mountains that had never been sighted. The Antarctic Plateau was almost wholly

Hydrologists measure the flow of a meltwater stream in the Dry Valleys region (Antarctic Division, NZ).

unknown and no-one had ever experienced a winter at any point inland upon its surface", wrote Law.

No-one knew how high it was or how cold it was. Many of the glaciers had not been examined, and studies on plants, animals, and birds of the region had hardly been started. The scientists were entering a new world.

One of the first tasks was to make an accurate map. The coastline stretches for thirty-three thousand kilometres, and is difficult to chart accurately because often the ice cover disguises the true shoreline. Both sailing ships and iron-hulled steamships had trouble taking accurate sightings. Aerial surveys proved to be a more accurate and economic way of gathering the information needed to draw up charts. Land parties could make these charts more accurate, by fixing precisely the positions of features such as mountain peaks.

Biologists studied the animal and bird life of the continent. By collecting specimens and observing the habits of seals, and of penguins and other birds, they learned how each species survived in the harsh Antarctic climate. They measured and catalogued specimens, observed breeding habits, noted how the different species of wildlife related to each other, and investigated how the food chain worked.

A major source of fascination the Antarctic held for the scientists of the 1950s was that it was almost completely unaffected by humans. Apart from the activities of whalers and sealers (which had greatly declined) the animal life lived in a natural state of balance. The continent was free of the pollution of industry and nuclear experiment.

The IGY

The International Geophysical Year (IGY) was the beginning of something new and exciting. The IGY was a worldwide program of co-operation in geophysical research. It was organised by the International Council of Scientific Unions, and nearly all countries of the world took part. Eleven countries (Argentina, Australia, Belgium, Chile, France, Great Britain, Japan, New Zealand, Norway, the USA and the USSR) put aside their differences and agreed to work together closely on research programs in Antarctica. This was the start of a spirit of international co-operation that has made Antarctica different from any other part of the world. A special committee was formed to co-ordinate the research programs. This committee later became the Scientific Committee for Antarctic Research (SCAR), and it still carries on its role of co-ordination and co-operation.

The IGY actually lasted eighteen months, from mid-1957 to the end of 1958. The planning had started years earlier and there were already twenty bases in the Antarctic region by 1954, all but one (Mawson) on the Antarctic Peninsula and nearby islands. This number increased to forty by 1957.

Stores at Casey station
(L. Goldsworthy - Fund for Animals).

The Americans and the Russians played important roles in the IGY, although they had major political differences at the time. The Americans built McMurdo Station and established the Scott-Amundsen Base at the South Pole. When members of the base flew in, they were the first people to set foot at the Pole since Scott.

The Russians built a large station, Mirny, near where Mawson's western party of 1911 was located. From here they set up a small station, Vostok, at the South Geo-magnetic Pole, about nine hundred kilometres from the coast. A second Russian base was at the Pole of Inaccessibility, the point most remote from the Antarctic coast in all directions.

To back up the work being done at Mawson, Australia established a second station for the IGY - Davis. ANARE geologists and surveyors from Mawson and Davis covered the vast area from Prydz Bay to Enderby Land, helped by land-based and ship-based aircraft. Relief ships of the Australian and Russian expeditions explored and mapped over six thousand kilometres of the coastline of the Australian sector. French, Russian, Australian, Japanese and South African expeditions explored the interior and carried out extensive glaciological investigations.

Never before had the scientists of the world shared their information and ideas so freely. The McMurdo base was an example of co-operation. Meteorologists from Argentina, Australia, France, New Zealand, South Africa and the Soviet Union all used the facilities there. John Bĕchervaise, Australian expeditioner and author, remarked that he was welcomed at the Soviet, Australian, New Zealand, French and American bases and encouraged to examine their scientific work.

During the IGY, the Commonwealth Trans-Antarctic Expedition crossed Antarctica from one side to the other. It followed the route planned by Shackleton forty years before from the Weddell Sea, through the South Pole, then on to the Ross Ice Shelf. The party was led by Dr Vivian Fuchs. Sir Edmund Hillary met Dr Fuchs at the Pole with fresh supplies. He made his part of the crossing in a modified Ferguson farm tractor.

The new bases

The explosion of scientific interest in Antarctica during IGY brought a sudden increase in the number of bases. By the end of 1958 there were fifty, belonging to twelve countries. There are still over forty. In summer over two thousand people live in them but in winter the population drops to around eight hundred. The two largest bases, McMurdo (USA) and Molodezhnaya (USSR) account for a third of the Antarctic population. Most other bases are small, housing twenty to thirty people. Permanent bases have been established on the continent and nearby islands and on the sub-Antarctic islands by Argentina (9), Australia (4), Chile (3), France (4), India (1), Japan (2), New Zealand (2), Poland (1), South Africa (3), Britain (6), USA (4), USSR (7) and West Germany (1).

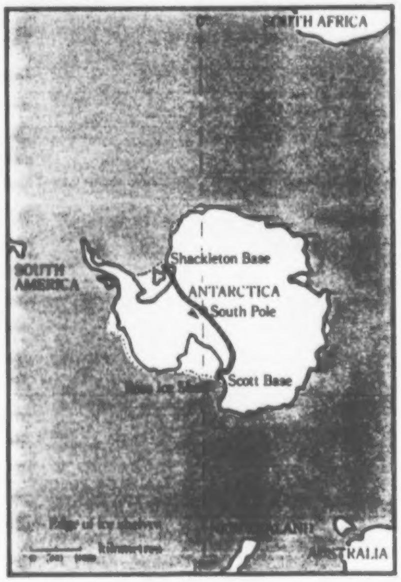
Most bases are run by government polar agencies, often with help from the armed services. Scientific work varies from base to base. Some act as biological laboratories, some are weather stations, some study upper atmosphere physics.

Building a base in Antarctica poses special problems. Most are contructed on ice, which is always moving and unstable. It is hard to build foundations. Huts give off heat, and will slowly sink into the ice. The British found that their base at Halley had sunk nine metres, and it had to be replaced. Snow and ice pile up around buildings, gradually covering them. Byrd station (USA) was completely covered in five years. The weight of ice and snow starts to squeeze and crush walls and roofs, and buildings can collapse.

So designers looked at new ways to solve these problems. Buildings at the Australian base of Casey (1969) are on a long platform raised on stilts. A long curved wall links the buildings and faces the wind. Snow blows underneath the platform and cannot pile up against buildings. The new Byrd station (1961) was built in a great trench cut in the ice, and covered by a steel arched roof. The South Africans put their buildings in a galvanised steel tunnel in an ice trench.

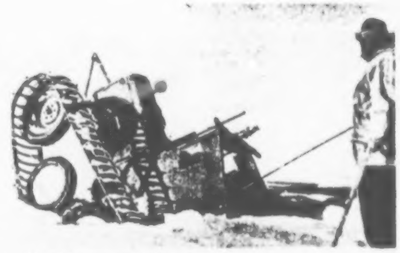
The US Amundsen-Scott base, built right at the South Pole in 1957, sank ten metres, and was dragged more than a kilometre from the Pole by the moving ice. So between 1971 and 1975 the Americans rebuilt the station beneath a single huge geodesic dome, fifty metres across. It was a far cry from the cramped, cold weatherboard huts in which the early explorers spent their long Antarctic nights.

Fuchs' and Hillary's route, 1957-58



Activities

1. How did exploration in the heroic age differ from that after 1940?
2. You are part of Phillip Law's party establishing Mawson base in February 1954. Describe what you saw over the first eleven days.
3. On a map of Antarctica mark the bases named in this chapter.
4. What happened during the IGY?
5. List some of the problems of building a base in Antarctica, and the way they can be handled.



Problems with a crevasse on the Trans-Antarctic Expedition of 1956-58. This is one of Hillary's Ferguson tractors (Crowther Collection).

WELTPARK ANTARKTIS
GREENPEACE

"No commercial exploitation of the Antarctic".
Greenpeace demonstration

An ice cliff at West Bay, Mawson (Antarctic Division, Australia - photo Max Cutcliffe).

Chapter 11

Living and working in Antarctica: the new explorers

Living conditions

An Antarctic base, such as Mawson, has a long night of six weeks in midwinter and an equally long day in midsummer. The wind blows almost continuously, at an average of forty kilometres an hour. Gusts of up to two hundred and sixty kilometres an hour have been recorded.

The climate is severe, and has some strange effects. At minus 35°C, butter splinters, and warm water will freeze as it is thrown from a cup onto the ground. Fish pulled out of the ocean give a convulsive shudder, then freeze solid. Touching metals can cause painful frost burns. At minus 40°C, mercury in a thermometer freezes and tin disintegrates. Other metals become brittle. The air is so dry that wooden huts will burn very easily, and, of course, water is in short supply because it all has to be melted, and kept melted.

Noel Kemp, an Australian geologist, describes what happened to him when he was trying to take a reading from a sextant one cold day. It was minus 30°C, and he was holding his breath as he adjusted the instrument: "I couldn't hold my breath any longer, and gently exhaled. The freezing of my breath attached my eyelashes to the eyepiece (of the sextant) and I had to pull the eyepiece out, go to the living van and thaw out over the stove."

People working in Antarctica dehydrate quickly. The water level in their bodies drops as they breath in dry air, but breathe out moist air. Sucking snow helps a little, but after a long work session, people lose a lot of weight. They need to drink lots of water to compensate, even if they don't feel thirsty.

Noel Kemp found that his skin suffered. He used zinc cream to protect it against sunburn, especially from light reflected upwards from the snow. His nose dripped constantly, because the moist air he breathed out condensed immediately. This gave him a sore upper lip that needed treatment with a cod-liver based ointment. The skin on his hands developed cracks and sores. Barrier cream helped solve that problem.

A stressful life

Living in the Antarctic can be hard on the mind as well as the body. Two of the crew members of the *Belgica*, the first people to spend a winter in the Antarctic, went mad under the strain of living in such close quarters. They had no fresh food, female company, news from home, and during the long winter, no sun. That was in 1898, but the same stress exists today.

People have strong personal reactions to the isolation and the strange environment. They have to live, eat, sleep and work within the same small group. There is not much privacy at an Antarctic station, and little chance to travel away from it.

Moving further than a few hundred metres from the buildings is literally an expedition. Wintering parties spend fifteen months at their

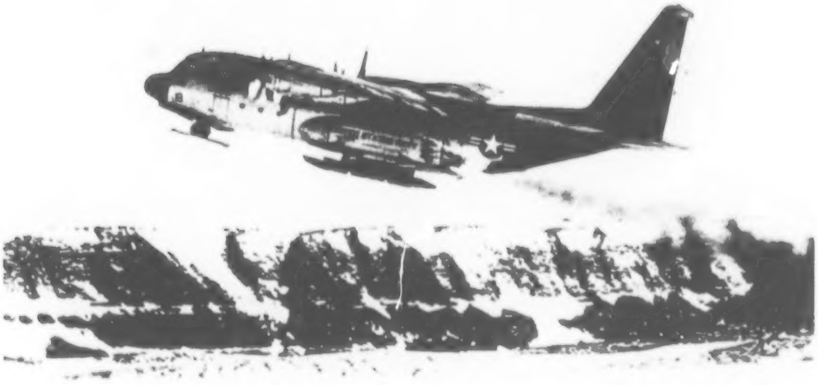
Sub-Antarctic settlement: King Edward Cove on South Georgia Island. Government buildings in the foreground and whaling station beyond (National Library of Australia).

base. Apart from radio contact, they are completely cut off from the outside world by the weather, the long night and the frozen sea.

Doctors have been studying the behaviour of members of the wintering parties ever since Frederick Cook wrote about the crew of the *Belgica*. Some personalities are more likely to adapt to Antarctica than others. They are usually open-minded and tolerant people, hard workers who are good at their job, and people who make good use of their leisure time.

People who are surly and argumentative and who do not work hard have problems which worsen under the stress of the long dark winter. But it is still difficult to predict with certainty before a person has been tested by the reality. Phillip Law gives examples of how personalities changed after arriving in Antarctica. For example, an easy going, hard-working person might become aggressive and morose. Often, once on board ship to return home, personalities changed back to normal.

Some people become very anxious, and apprehensive. They worry about their jobs, and develop symptoms of serious illnesses. Law talks about expeditioners who were diagnosed as having heart and gall bladder problems. The medical symptoms vanished as soon as the sufferers were removed from the cause of their anxiety. In the gall-bladder case, the patient's symptoms disappeared when the relief ship arrived and he was transferred to it. Later he had to go back on shore to talk to his replacement and the pain returned.



A heavily-laden Hercules is boosted into the air by jet-assisted take-off rockets (U.S. Navy).

Preparing for Antarctica

Law interviewed applicants for expeditions for eighteen years. His first requirement was that the person should love his job. "If his job is also his hobby, he will never be bored in Antarctica." The second quality he looked for was unselfishness, closely followed by tolerance. He wanted people of character, of "guts and stickability", optimists who would not cast gloom on projects before giving them a chance to succeed. Age was not important, provided the applicant could pass a tough medical examination.

Successful applicants go through an orientation and training program. They talk to Antarctic veterans to learn about their experiences. They are introduced to survival techniques, and learn about the different methods of transport.

This orientation program is usually followed by a training session in the field. Americans and New Zealanders attend a three-day snowcraft/survival school on Ross Island, near the spot where Scott had his base camp. Australians spend a week at the Bernacchi Training Centre in the Tasmanian highlands.

Expeditioners are introduced to the sorts of clothing and gear they will be using in Antarctica. They are taught safety and emergency techniques, such as building igloos and roping together when crossing crevasses. They learn how to use radios and motorised toboggans, to read maps, fight fires, and give first aid.

Doctors going with the expeditions need to spend some time at a large general hospital. Here they rehearse the wide range of operations they might have to perform, from an emergency following an accident to removing an appendix. Two other expeditioners are needed to assist the doctor - one to give anaesthetics, and the other to act as a theatre nurse. They too spend time training in a hospital before they leave for Antarctica.

Understanding Antarctica

Antarctica is a place to observe our world in conditions of extreme cold. It also provides a convenient window from which to peer out at the atmosphere and space, because of some of the special things that happen there.

Understanding Antarctica will help scientists understand the rest of the world better. One hundred and sixty million years ago, Antarctica was joined with Australia, New Zealand, India, South America and Africa in one giant land. This super-continent has been named "Gondwanaland" by recent geologists. They believe it broke up and drifted apart over the following one hundred million years.

Modern explorers still use some of the old ways. A scientist travelling by dog sledge piles snow on the skirt of his tent (Antarctic Division, Australia).

In testing this theory, geologists have worked out how the continents could have fitted together, like putting a giant jigsaw puzzle back. They closely compared rocks from Antarctica with rocks in other lands at the places where they are supposed to have been connected with Antarctica. If the rocks and minerals match up, then the land areas would have once been joined. In this way geologists have supported the supercontinent theory.

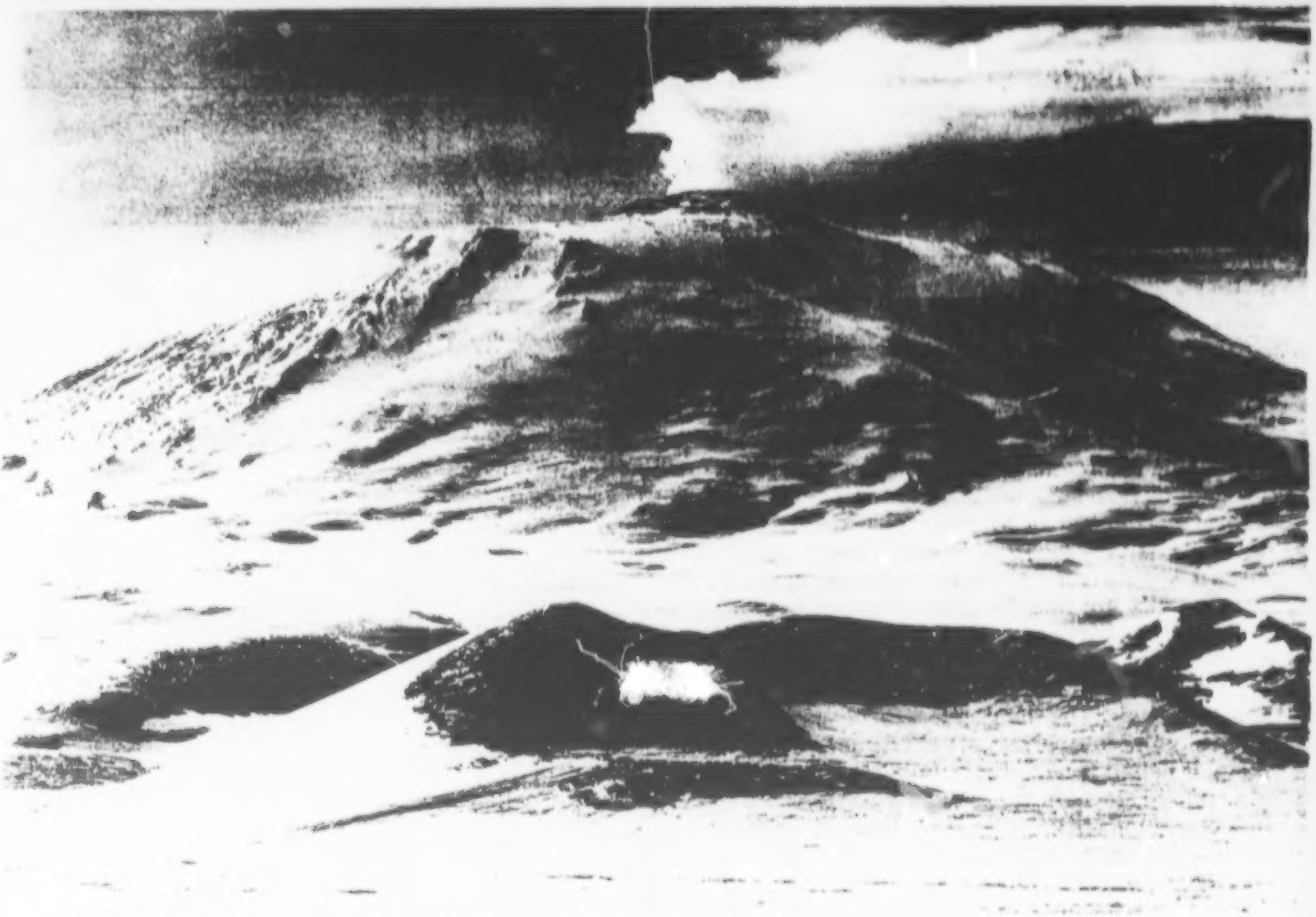
Geologists have also found more meteorites in Antarctica than anywhere else in the world. After being heated up by passing through the Earth's atmosphere,the meteorites which struck Antarctica melted through the top layers of ice. When they cooled, they froze into the ice.

Many meteorites are at the bottom of the ocean. The ice in which they were trapped slid down very slowly and gradually into the sea, where it broke off to form icebergs. The icebergs then drifted north until they melted, dropping the meteorites into the depths of the Southern Ocean.

But not all ice reaches the sea. Some runs into obstacles such as a mountain range and is forced upwards by the pressure of the ice behind. In some areas, called 'ablation zones', wind evaporates the ice surface away, to reveal a collection of meteorites. They are usually pebble sized, and are useful in helping scientists work out how the solar system has developed and changed.

The Antarctic ice sheet is made up of layers of ice. Each one was originally the snowfall of a particular year. A complete record of the climate of Antarctica is contained in the ice. Scientists can examine this record by drilling deep down into the ice cap with a hollow drill and collecting core samples. They can tell what happened in a particular year by counting down the layers - one layer per year - and studying the ice sample.

The glaciologists who collect this information can work out what happened to the climate in the past. By understanding the past, they can then start to predict the future more accurately. The deeper the holes go, the further back into the past. Borehole drilling in the Australian sector in 1984 included holes four hundred and seventy-five metres deep. At this depth, the simple counting down of layers is not an accurate method of dating the samples of ice. Scientists use more sophisticated methods , such as isotope dating. At the same time, getting to know the present land of Antarctica is still a mighty challenge.



A plume of water vapour rises from Mt Erebus on Ross Island, one of the few active volcanoes in Antarctica (N.R. Kemp).

Just measuring the ice sheet is a major task. Is it getting larger or smaller? If the whole ice sheet melted, the oceans of the world would rise by at least forty-five metres, and this would flood many major cities - New York, London, Melbourne and Auckland, for example. To work out whether the ice sheet is increasing or decreasing, the glaciologists have to know two things: how much ice has broken off Antarctica to float north and melt; and how much snow has fallen in the same year.

A reasonable estimate of iceberg activity can be made by using satellite photos. Measuring snowfall is more difficult. It is hard to separate old snow and ice, as it is hurled along by the wind in a blizzard, from snow which is freshly falling.

Icebergs and weather

The icebergs have another practical interest for people in other lands. They could be a source of water for the drier parts of Australia, Africa and South America. The icebergs would need to be towed by giant tugs to the coast of the dry country, where the ice would be melted and pumped on shore.

About one thousand two hundred square kilometres of icebergs are calved from the ice shelves every year. Ten per cent of this, converted back to water, would be enough to satisfy the needs of an urban population of five hundred million - America and Russia together - for a year.

Engineers have worked out that tugs of the future could tow an iceberg eleven by three kilometres and two hundred and fifty metres thick, at a speed of about two kilometres per hour. It would take one hundred and sixty days to tow an iceberg from the Amery Ice Shelf to Australia. About twenty per cent of the ice would melt on the way.

There are still many problems to be solved with this scheme. The powerful tugs have not yet been built. The melting process would have to be limited. Such icebergs might ground twenty kilometres offshore, and the method of melting the ice and transferring it to land has not been worked out.

Antarctica is also important because of its enormous effect on the world's weather. Cold air from the vast ice sheets moves north at low altitudes, as hot air from equatorial regions streams south at high altitudes. Cyclones swirl around the continent in a clockwise direction. Meteorologists'work in Antarctica will lead to a better forecasting of both day-to-day and long range weather. It might also provide information about long-term climatic cycles - for instance, the causes of the Australian drought of 1978-1982, or the tragic drought in north-eastern Africa.

Meteorologists in Antarctica use both modern and traditional methods as they measure temperature, air pressure and humidity, and record wind, rain, snowfall, and cloud cover. More sophisticated instruments are fitted in the automatic weather recording stations, in balloons fitted with electronic equipment, and, of course, the satellites orbiting around our planet.

A study of the upper atmosphere of the earth is leading to a better understanding of our long-term weather patterns. Observing the aurora, a great shimmering curtain of light hanging in the sky far above the Earth's poles, is helping scientists to understand more about charged particles in electric and magnetic fields - important for astronomy, energy production and communications.

Most expeditions include a magnetician, who measures the Earth's magnetic field, and checks any changes in its direction or intensity. The Earth behaves like a giant magnet, with the poles (or ends) in the Arctic and Antarctic. Compasses work by pointing to these magnetic poles (which are not the same as the geographical North and South Poles). The magnetic poles move all the time. Their positions have to be checked regularly. Records show that the South Magnetic Pole has wandered seven hundred kilometres in much less than a century.

The scientists of today who study the rocks, ice and weather of Antarctica are continuing the work started by Borchgrevink, Scott and Mawson. They are the modern explorers, who are unlocking the secrets of the frozen continent.

Field work on the ice (Allan Brand).

A light, transportable pre-fabricated fibreglass dome used by field parties (Antarctic Division, Australia).

Activities

1. Why do people dehydrate so quickly in Antarctica?
2. If you were interviewing expeditions to go to Antarctica, what would you look for?
3. You have been picked to go to Antarctica. List the preparations you make.
4. How could icebergs be useful outside Antarctica?
5. Research: find out more about what a geologist, a glaciologist or a meteorologist does.

Bedding down with Adelie penguins (National Geographic - photo Gill Cracknell).

Two Hughes 500 helicopters ferry-in German scientists and supplies to an American summer base camp, German expedition of 1981-82 (N.R. Kemp).

Chapter 12

The future

The Antarctic Treaty

The idea of the Antarctic Treaty arose out of the International Geophysical Year. The research carried out in the IGY was so useful that the eleven countries concerned, together with a later arrival, South Africa, worked out a more permanent arrangement.

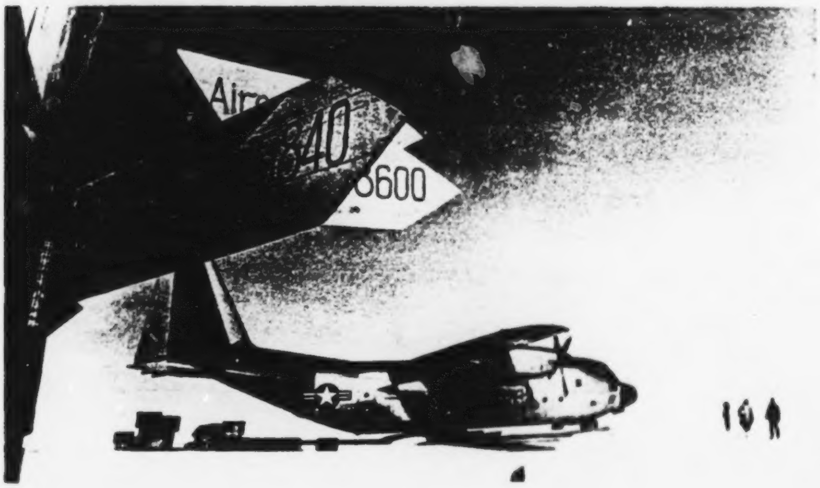
The Treaty was negotiated in 1959, and set out the way activities should be conducted south of sixty degrees latitude. Some important parts of this treaty say that:

- Antarctica shall be used only for peaceful purposes. Any military activities are banned.
- The results of all scientific research in Antarctica shall be freely exchanged between countries.
- Scientists can visit and work at Antarctic bases run by other countries.
- Nuclear explosions or dumping radioactive waste material are banned.
- Any member nation may send a team to inspect any other nation's station, to satisfy itself that the Treaty conditions are being observed.
- The living resources of Antarctica shall be protected.

The Treaty became effective in 1961 for the twelve nations which signed it. They were Argentina, Australia, Belgium, Britain, Chile, France, Japan, New Zealand, Norway, South Africa, the Soviet Union and the United States. These countries, which had shown that they had done major scientific work in Antarctica, became known as "Consultative Parties". Since then an additional six countries have also become Consultative Parties following the establishment of scientific stations in Antarctica: Poland, the Federal Republic of Germany, Brazil, India, China and Uruguay.

In addition a further fourteen countries which are not actually involved in Antarctica have "acceded" (or agreed to be bound by) the Treaty: Czechoslovakia, Denmark, the Netherlands, Romania, the German Democratic Republic, Bulgaria, Cuba, Finland, Hungary, Sweden, Papua New Guinea, Italy, Peru, and Spain.

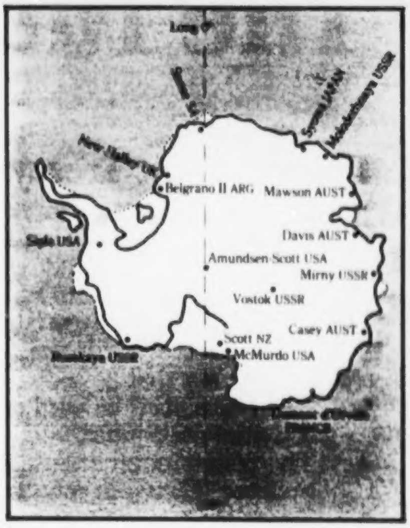
Carstens Borchgrevink in 1884 (National Library of Australia).



Far from home, a ski-equipped Hercules sits on the ice. Operation Deep Freeze, 1969 (U.S. Navy photo, Quartermain Collection, Canterbury Museum).

So there are currently thirty-two countries bound by the terms of the Antarctic Treaty. Treaty parties hold meetings every two years to consider issues which arise in the Antarctic context, such as environmental protection. Decisions are reached by consensus (that is, by common agreement) amongst the Consultative Parties. Other Treaty parties are invited to the meetings as observers. They may speak but are not allowed to vote.

Some Antarctic Bases



International co-operation

The Treaty is a very short agreement of only fourteen articles. However, it has been successful in helping countries to co-operate with each other in the Antarctic for over a quarter of a century. Australians, for instance, have joined New Zealand, Soviet and American expeditions and vice versa, while all of these countries have made use of the United States' Landsat satellites for mapping and surveying. At times, Australia has been helped by aircraft of the Royal New Zealand Air Force, the United States Navy and the Soviet Union. Russian planes have refuelled at Australia's Mawson base.

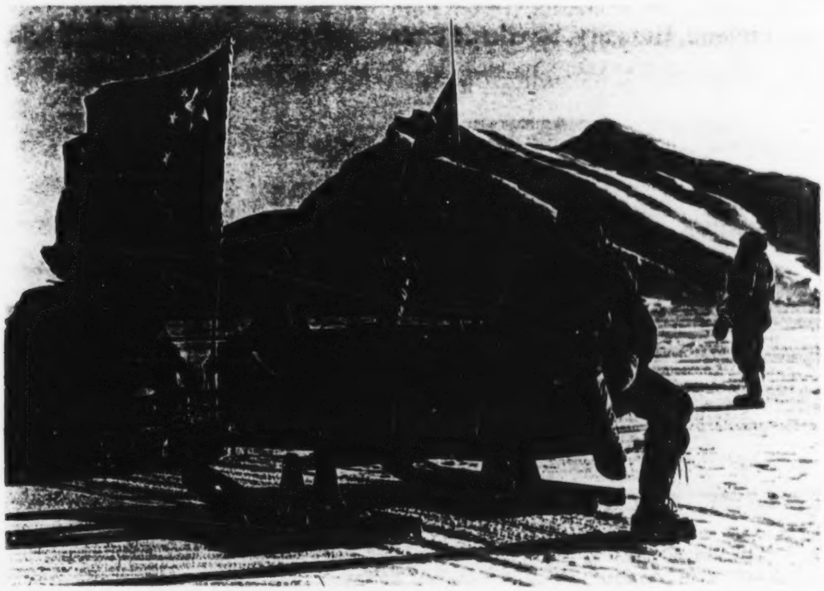
Rescue missions have been international, too. The Russians have come to Australia's aid; a South African ship was freed from the ice in 1985 by the join efforts of Russian and Australian ice-breakers. Co-operation crosses the boundaries of politics and ideology.

Countries also co-operate in other ways. For instance SCAR has helped the treaty nations protect the Antarctic environment, by giving them information and expert advice. In this way there is a constant concern for the future of the continent.

Some international matters have not yet been decided:

- If someone commits a crime in the Antarctic, under whose criminal laws is the person tried?
- The sea is rich with fish and krill, and mining and oil companies are beginning to show an interest in the area. Are the resources of Antarctica to be developed, and if so, how?
- And how should pollution be controlled?

All these matters are complicated because seven countries claim that parts of Antarctica belong to them. Argentina, Australia, Britain, Chile, France, New Zealand and Norway all claim ownership of parts of Antarctica, often



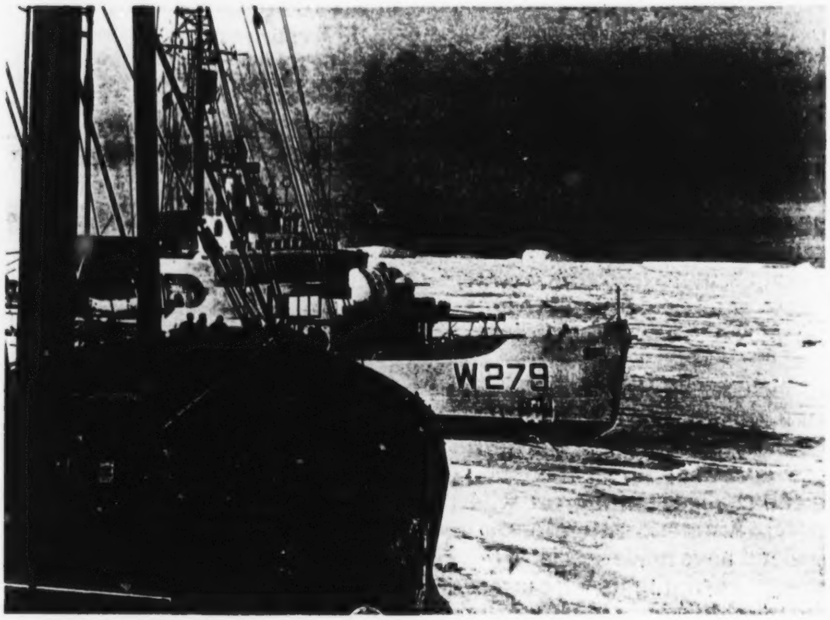
Chinese and Australian scientists on a field trip (B. Sorensen).

shown on maps as sectors shaped like slices of a pie. Most other countries refuse to recognise these claims.

The twelve nations worked on the Treaty for many years before they all signed it. Even then, they could not agree on the matter of territorial claims, because it was too difficult to sort out. They put it to one side and agreed that just because a country signed the Treaty, it did not have to give up a claim to owning part of Antarctica. Nor did it mean that a country signing the Treaty agreed to anyone else's claim. But no country could improve its chances of making a successful claim because of work it carried out in the Antarctic while the Treaty was in operation.

Australia claims by far the largest area in Antarctica. The Russians, however, have four bases sited in the Australian Antarctic Territory. Relations between the two countries are good. But what happens if profitable resources are found in the territory Australia claims? Who owns them? The Russians, like the Americans, do not recognise Australia's claims on Antarctic territory.

Roald Amundsen in polar kit (National Library of Australia).



A U.S. Coastguard icebreaker assists *Thala Dan* in heavy pack ice (Antarctic Division, Australia - photo D. Macklin).

Antarctic resources

Antarctica is no longer the mystery land of even thirty years ago. The resources and the potential of the continent are becoming better understood. Now that governments understand more about what is there, they are turning their attention towards making use of the region.

There are three groups of Antarctic resources. Living resources make up the first group. Of all the animals and fish that live in Antarctic waters, krill are the most interesting. They are small shrimp-like creatures, rich in protein. They are the main food of whales, seals, penguins, some sea birds and fish, and a vital part of the Antarctic food chain.

Both Russia and Japan need new sources of food, and have been trawling for krill. Research on the effects of krill harvesting is still taking place. If krill are trawled heavily, it could affect all the sea creatures who depend on it for food.

Whaling is dying out. The 1984-85 quota was 4,224 for minke whales, and the quota was zero from the 1985-86 season. Some countries,

Filming Antarctic wildlife (B. Sorensen).

notably Russia and Japan, however, continue to hunt whales, although in fewer numbers. There are quota limits on some seals, and the rest are protected. Fishing boats catch about 100,000 tonnes of cod, ice-fish, and southern blue whiting per year, but fish breed and grow slowly in Antarctic waters. The possibility of harvesting squid and seaweed are being investigated.

The second group of resources is oil and minerals. The Gondwanaland theory holds that Antarctica was once joined to Australia, New Zealand, India, South America and Africa. It seems logical that the minerals found in these countries should also be found in the Antarctic.

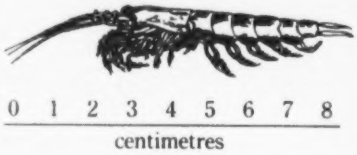
Mining and drilling are going to be difficult, with a thick ice sheet covering ninety-eight per cent of Antarctica. Some deposits of minerals have been found, but they are either small or of low quantity. It is not worth mining these deposits of coal, iron ore or copper at present.

Traces of hydrocarbon gases have been found in the ocean bed around Antarctica. This could mean that oil is present. If drilling for oil goes ahead, the difficult conditions might lead to a disastrous oil spillage. The drillers would have to battle gales, blizzards, pack-ice, icebergs and the cold.

Krill in the laboratory (National Library of Australia).

A large number of people would be needed to operate the oil rigs. They would probably live in houses on the coast of Antarctica, built on one of the rare rocky outcrops. There are not many of these rocky areas, and penguins use them as nesting places. The people would be competing with penguins for space. They would have to dispose of rubbish and sewage, a difficult problem in the special conditions of Antarctica.

The Antarctic Treaty nations are currently discussing a set of rules under which mining or drilling could take place. The minerals are not needed now, but the pressure to exploit them may become greater in the future. Until ways of protecting the environment of Antarctica are worked out, there is a total ban on the exploration and mining of minerals by the Treaty countries.



KRILL

The third group of resources includes all other possible uses that could be made of Antarctica. Towing icebergs north to provide a water supply for the drier parts of Australia, the west coast of North America, South America and Africa is one. Tourism is another possibility. Antarctica offers both beauty and the challenge of a great wilderness. Cruise ships have offered short trips into Antarctic waters for the last ten years. Both Qantas and Air New Zealand have made special sight-seeing flights over areas of spectacular scenery. These flights were discontinued after an Air New Zealand jet crashed into Mt Erebus in 1979, killing over two hundred passengers and crew.

The resources of Antarctica are going to be used. The question of how this will occur has not yet been decided. Human history in Antarctica has been peaceful so far. The conflicts which erupt in the rest of the world have not yet reached its shores. It will take great commonsense and goodwill to maintain the international co-operation and harmony which is still the finest achievement of human activity in Antarctica.

International cooperation: A Russian helicopter airlifts a seriously ill Australian from Davis (Antarctic Division, Australia - photo D. Ward).

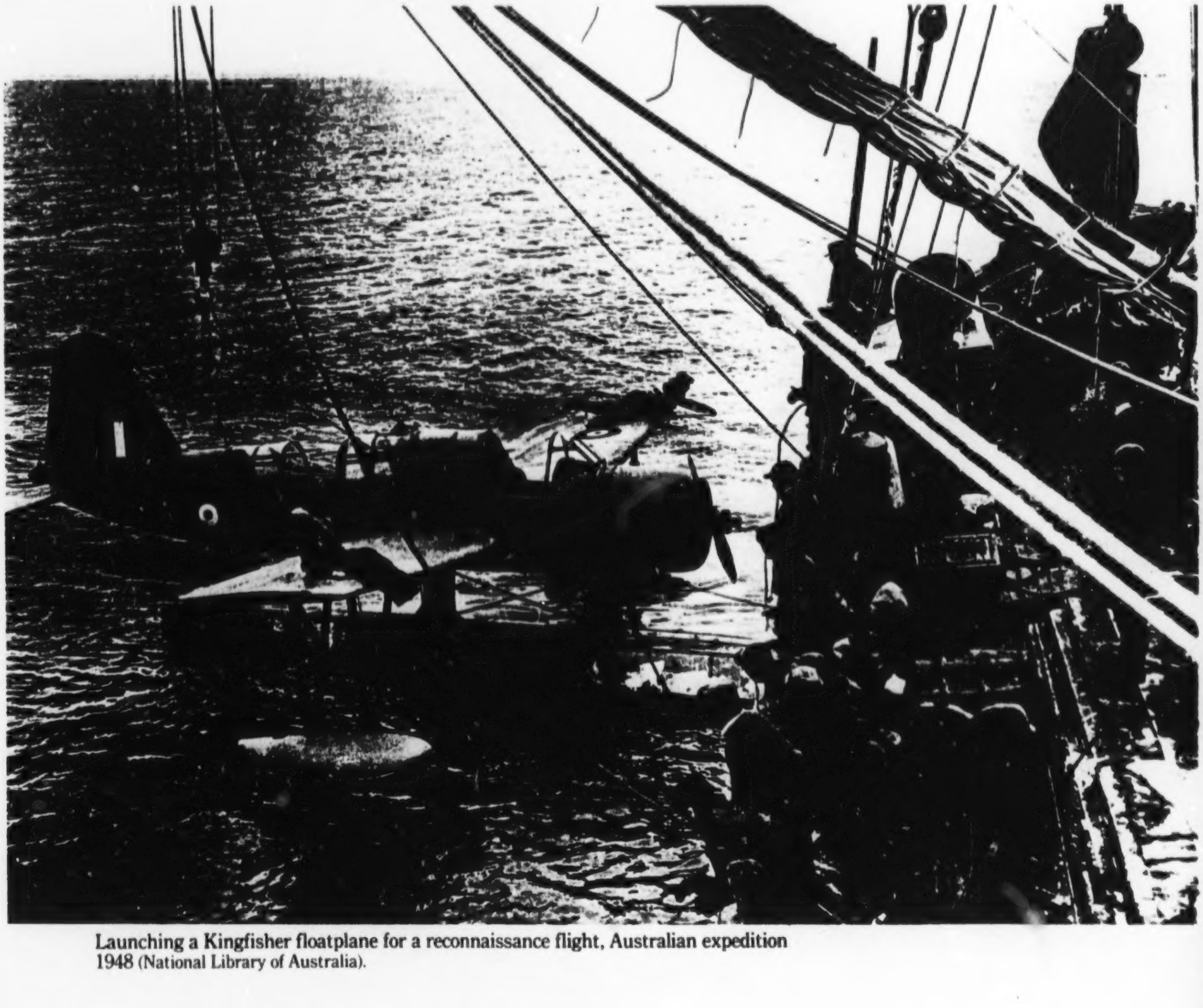
CONFERENCE ON THE CONSERVATION
OF ANTARCTIC MARINE LIVING RESOURCES

Protecting a fragile environment: a meeting of the C.C.A.M.L.R.

Antarctic rubbish dump

Activities

1. On a blank map of the world, find and colour in the countries that are (a) Consultative Parties and (b) Acceding (or Contracting) Parties to the Antarctic Treaty.
2. How did the Antarctic Treaty come about?
3. How do countries co-operate with each other in the Antarctic?
4. Choose one of the matters that has not yet been decided - crime jurisdiction, resource use, pollution or territorial claims. What is your solution to this problem?
5. Make a list of the items which make up the three groups of Antarctic resources.



Launching a Kingfisher floatplane for a reconnaissance flight, Australian expedition 1948 (National Library of Australia).

Iceberg cavern, Scott's expedition (National Library of Australia - photo Herbert Ponting).

Weddell seals (National Library of Australia - photo Herbert Ponting).

Seals basking in the summer sun on pancake ice (National Library of Australia - photo Herbert Ponting).

Appendix A

Voyages of discovery and exploration

		Nationality	Ship
1520	*Ferdinand Magellan* Passed through Magellan Straits between South America and Tierra del Fuego	Spanish	*Trinidad*
1578	*Francis Drake* Blown south, found Drakes Passage south of Tierra del Fuego	British	*Golden Hind*
1592	*John Davis* Discovered Falkland Islands	British	*Desire*
1675	*Antonio de la Roche* Blown south, discovered South Georgia island	British	
1738-39	*Jean-Baptiste Bouvet de Lozier* Sighted flat-topped icebergs, discovered Bouvet Island.	French	*Aigle, Marie*
1771-72	*Marion Du Fresne* discovered Prince Edward and Crozet Islands.	French	*Mascarin, Marquis de Castries*
1771-72	*Yves Kerguelen-Tremarec* Discovered Kerguelen Islands. Expedition to settle them in 1773-74 failed.	French	*Fortune*
1772-75	*James Cook* Circumnavigated Antarctica without ever seeing it. Reached 71°S. First crossing of Antarctic Circle	British	*Resolution, Adventure*
1791	*George Vancouver* Discovered Snares Island, south of New Zealand	British	
1800-01	*Edmund Fanning* First large-scale sealer in Antarctica.	American	*Aspasia*
1810	*Frederick Hasselborough* Discovered Macquarie Island and Campbell Island	British	*Perseverance*
1819	*William Smith* Discovered South Shetland Islands.	British	*Williams*
1819-21	*Thaddeus von Bellingshausen* Circumnavigated Antarctica and first to sight mainland, 27 January 1820.	Russian	*Vostok, Mirny*
1819-20	*Edward Bransfield* First to chart part of mainland, on the Antarctic Peninsula.	British	*Williams*
1820-21	*Nathaniel Palmer* Sighted Antarctic mainland.	American	*Hero*
1820-22	*John Davis* May have been first to set foot in Antarctica, 7 February 1821.	American	*Cecilia*
1821-22	*George Powell and Nathaniel Palmer* Discovered South Orkney Islands.	British and American	*Dove, Eliza*
1821-22	*James Weddell* Reached 74°S and discovered Weddell Sea.	British	*Jane*
1830-32	*John Biscoe* Sighted Enderby Land and Graham Land on Antarctic continent.	British	*Tula*
1833	*Henry Rea* *Rose* crushed in pack ice near South Shetland Islands	British	*Hopefull, Rose*

Voyages of discovery and exploration

		Nationality	Ship
1837-40	*Jules-Sebastian Dumont d'Urville* Discovered more coastline, first national expedition to Antarctica. Led to French claim to Adelie Land.	French	*Astrolabe*
1838-42	*Charles Wilkes* First US Government expedition, sighted tract of coastline now called Wilkes Land.	American	*Vincennes*
1839-43	*James Ross* Broke through pack ice to chart eight hundred kilometres of coastline in the Ross Sea area. Discovered the volcano Mt Erebus, Ross Island and Ross Ice Shelf.	British	*Erebus, Terror*
1872-76	*George Nares* Scientific research trip on first steamship to cross Antarctic Circle.	British	*Challenger*
1873-74	*Eduard Dallmann* First German expedition, Antarctic Peninsula region.	German	*Gronland*
1894-95	*Henryk Bull* Introduced successful whaling to Antarctic. First confirmed landing on the mainland of Antarctica near Cape Adare at the entrance to the Ross Sea, 24 January 1895.	Norwegian	*Antarctic*
1897-99	*Adrien de Gerlache* First men to winter in Antarctic when their ship was trapped by ice off the Antarctic Peninsula. First mate was Roald Amundsen.	Belgian	*Belgica*
1898-1900	*Carstens Borchgrevink* First group to live on mainland over winter, near Cape Adare.	British	*Southern Cross*
1901-03	*Erich von Drygalski* Explorers and scientists, second ship to winter in pack-ice. A number of features near Mirny were named at this time.	German	*Gauss*
1901-04	*Otto Nordenskjold* Scientific work over two winters on Snow Hill Island. First major sledge journey. Ship crushed in ice.	Swedish	*Antarctica*
1901-04	*Robert Scott* Large-scale program of scientific discovery and exploration from base on Ross Island. Reached 82⁰S, found route to the polar plateau. Experimented with methods of travel.	British	*Discovery*
1902-04	*W.S. Bruce* Scientific and exploration work, Coats Land.	British	*Scotia*
1904	*Jean Baptiste Charcot* Survey of western side of Antarctic Peninsula.	French	*Francais*
1904	*Carl Larsen* Start of modern Antarctic whaling, with establishment of first shore-based whaling station on South Georgia.	Norwegian	
1907-09	*Ernest Shackleton* From base camp on Ross Island got within one hundred and eighty kilometres of Pole. Mawson, an expedition member, climbed Mt Erebus, and also reached South Magnetic Pole.	British	*Nimrod*

Voyages of discovery and exploration

		Nationality	Ship/Aircraft
1908-10	*Jean Baptiste Charcot* Continued scientific and exploration work, western side of Antarctic Peninsula.	French	*Pourquoi Pas?*
1910-12	*Wilhelm Filchner* Explored Luitpold Coast at head of Weddell Sea.	German	*Deutschland*
1910-12	*Roald Amundsen* Establishes base at Bay of Whales on Ross Ice Shelf. First man to reach South Pole, on 14 December 1911.	Norwegian	*Fram*
1910-13	*Robert Scott* Scientific and exploration work from Ross Island base. Reached Pole one month after Amundsen, but died on return trip.	British	*Terra Nova*
1911-12	*Nobu Shirase* First exploration group from Japan. Worked mainly in Ross Sea area.	Japanese	*Kainan Maru*
1911-14	*Douglas Mawson* Exploration and scientific work. Bases at Commonwealth Bay, Shackleton Ice Shelf and Macquarie Island. Extensive coastal exploration by land parties.	Australian	*Aurora*
1914-16	*Ernest Shackleton* Failed attempt to cross Antarctica. His ship sank in the Weddell Sea.	British	*Endurance*
1914-17	*A.A.E. Mackintosh* Ross Sea party in support of Shackleton.	British	*Aurora*
1927-37	*Lars Christensen* Norwegian Antarctic expeditions claim several sub-Antarctic Island, explore more coast on mainland.	Norwegian	*Norvegia*
1928-29	*Hubert Wilkins* First plane flight in Antarctica. He flew from Deception Island south along the Antarctic Peninsula.	Australian	*Hektoria*
1928-30	*Richard Byrd* Explored from Little America on the Ross Ice Shelf. First flight over South Pole, 29 December 1929.	American	*City of New York,* *Eleanor Bolling*
1929-31	*Douglas Mawson* Two summer voyages for marine research. Made three landings, plotted parts of coast from sea and air.	Australian	*Discovery*
1933-34	*Lincoln Ellsworth* Trans-Antarctic flight attempted.	American	*Wyatt Earp*
1933-35	*Richard Byrd* Semi-permanent base at Little America II, Ross Ice Shelf. Scientific and weather stations. Byrd wintered alone at advance base.	American	*Bear of Oakland,* *Jacob Rupert*
1934-37	*John Rymill* British Graham Land Expedition. Exploration of Antarctic Peninsula (Rymill was Australian).	British	*Penola*
1935-36	*Lincoln Ellsworth* Flew from Antarctic Peninsula across continent, landing four times and reaching Little America.	American	*Wyatt Earp*
1938-39	*Alfred Ritscher* Air exploration of Dronning Maud Land leading to German territorial claims.	German	*Schwabenland*

Voyages of discovery and exploration

		Nationality
1939-41	*Richard Byrd* Exploration of Marie Byrd Land coast.	American
1944	British permanently occupied bases in Graham Land, Antarctic Peninsula.	
1946-47	*Richard Byrd and George Dufek* 'Operation Highjump', an extensive naval research and exploration program that circumnavigated Antarctica and used aircraft to photograph much of the coast.	American
1947	*Federico Toro* Established first permanent Chilean station in Antarctic peninsula area.	Chilean
1947-48	*Stuart Campbell and George Dixon* Established bases at Heard and Macquarie Islands respectively.	Australian
1947-48	*Finne Ronne* Exploration of Antarctic Peninsula by private expedition. Included first women to winter in Antarctica at base on Stonington Island.	American
1947-48	*Gerald Ketchum* US Navy 'Operation Windmill' - survey work using helicopters along route of 'Operation Highjump'.	American
1947	*Luis Garcia* Permanent weather stations established in Antarctic Peninsula area.	Argentinian
1949-52	*John Giaever* Joint Norwegian-British-Swedish expedition set up base in Dronning Maud Land. First truly international venture.	International
1954-66	*Phillip Law* Established Australia's first station at Mawson, February 1954. Between 1954 and 1966 led nine ANARE voyages of exploration along the coast of Greater Antarctica.	Australian
1956	*Mikhail Somov* First USSR base at Mirny established.	Russian
1956	*George Dufek* Operation 'Deep Freeze' - plane lands at Pole, the first people there since Scott in 1912.	American
1956-57	Japan, New Zealand, America, Norway, Belgium and France establish bases.	
1957	*Phillip Law* Established Australia's second ANARE station at Davis.	Australian
1957	*Edmund Hillary* Establishment of Scott Base on Ross Island.	New Zealander
1956-58	*Vivian Fuchs* Commonwealth Trans-Antarctic Expedition crossed Antarctica from Weddell Sea to Ross Sea. Edmund Hillary laid down a supply route between Ross Sea and the Pole station. First to reach Pole overland since Scott.	British

Voyages of discovery and exploration

1957-58	International Geophysical Year (IGY) Twelve nations operated forty stations.
1959	Australia took over the US station at Wilkes.
1961	ANARE exploration along coast of Enderby Land.
1961	Antarctic Treaty came into force.
1962	US Navy installed nuclear power plant at McMurdo base. It was closed down in 1972 and waste and contaminated rock shipped back to US.
1962	Australian team undertook two-month traverse from Wilkes to Russian base at Vostok.
1965	Last Antarctic whaling station, on South Georgia, closed.
1968	Japanese team completed longest ever round-journey to Pole from their Syowa base and back (5,150 kilometres).
1969	Australia closed the ANARE Wilkes station and opened Casey.
1972-73	First single-handed voyage to Antarctica by David Lewis in *Ice Bird*.
1978	First birth in Antarctica - Emilio de Palma at Argentina's Esperanza base, January 1978.
1980-81	Transglobe Expedition circumnavigated the world via the two Poles. Second party to cross Antarctica overland.
1983	World's lowest temperature of minus 89.6°C recorded at Vostok base (USSR).
1984	World's greatest wind-speed of 213km/h recorded at Russkaya. (USSR).

Relaxation (Promotion Australia).

Appendix B

Pressure of wind index

The pressure the wind exerts against a person or building increases very quickly as wind speeds rise. To calculate the pressure, multiply the wind speed by itself.

Wind speed	Pressure of wind
10	100
20	400
50	2500
80	6400
100	10,000
213	45,369

This scale does not measure pressure in any units, such as pounds per square inch or newtons per square metre. It does show that when the wind speed doubles from 10 to 20km/h, the pressure goes up four times.

The world record wind speed was recorded at a Russian base in the Antarctic in 1984. At 213km/h, the wind pressure would be 45,369, or 450 times the pressure when the wind is blowing at 10km/h.

Appendix C

The windchill factor

People feel colder on a windy day because the wind increases heat loss from the body. The actual temperature does not change, but the body reacts as though it was colder. This is called windchill.

At a wind speed of:	5	10	20	40	80km/h
Actual temperature	It feels as though it is:				
20°C	20	18	16	14	13
10	10	6	2	-2	-6
0	0	-5	-12	-19	-27
-10	-10	-18	-28	-37	-42
-20	-20	-28	-40	-50	-59

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Appendix D

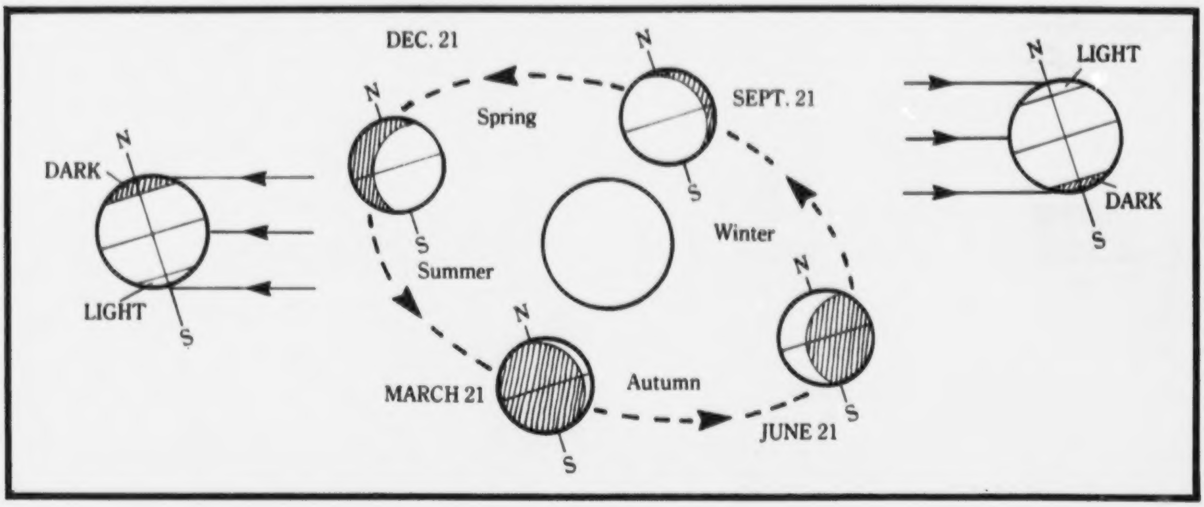
Antarctic seasons

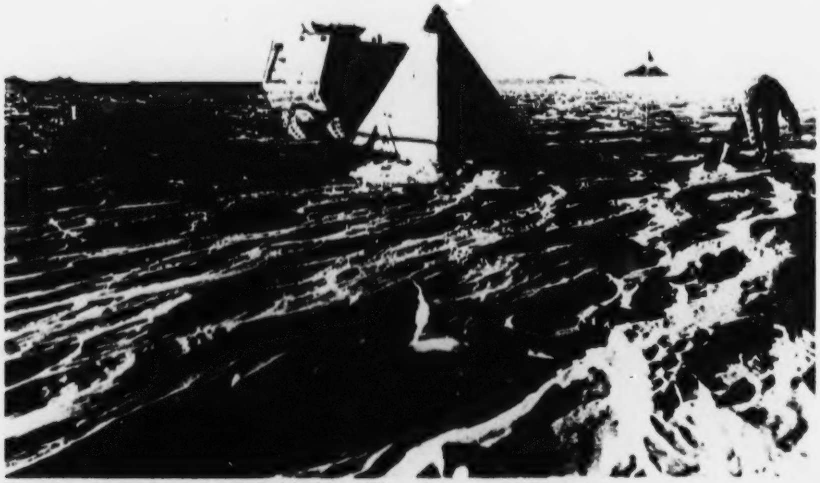
The Earth's axis is tilted at nearly 23.5° from the vertical. This, together with the movement of the Earth on its orbit around the sun, causes the changes that we know as the seasons. During the southern mid-summer, the sun shines continuously within the Antarctic Circle, so it is daylight all the time. At the Pole it is daylight for six months. In the mid-winter the suns rays do not reach the Antarctic. The night lasts up to six months at the South Pole itself.

Thus the Antarctic has both a long summer and a long winter. The terms spring and autumn scarcely apply. The closer one is to the Pole, the longer the periods of sunshine in summer and darkness in winter.

You can find out more about this in another book in this series, *The Polar Continent.*

Seasons for the Southern Hemisphere





Pitching a tent in sastrugi. Behind is a Weasel tractor with sledge (Antarctic Division, Australia).

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Photographing emperor penguins (Allan Brand).

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The books marked "*" were particularly useful.

Films

Early history and heroic age

Antarctic Pioneers (b/w, 1962). Account of Australian exploration of Antarctica. Frank Hurley recalls his first voyage with Mawson in 1911. Later voyages also described.

Antarctica (b/w, 1958). US film looks at exploration of Antarctica since James Cook. Includes scientific activity of the IGY.

Douglas Mawson: The Survivor (colour, 1982). Documentary reconstruction of Mawson's 1912 expedition on which Ninnes and Mertz died. Interviews with Mawson's daughter, his contemporaries and students.

Endurance (b/w, 1958). British film of Shackleton's 1914-16 and 1921 expeditions. Comprises footage shot by Hurley at the time, and re-edited in 1958.

Freezing Point (colour, 1975). American account of Amundsen's and Scott's race for the South Pole, with emphasis on how the early explorers survived in the hostile environment.

Man the Killer, Man the Keeper (colour,1978). History and wildlife of Macquarie Island. Looks at traces of early sealers. Includes footage by Hurley, shot during Mawson's visit in 1911.

Ninety Degrees South (b/w, 1939). Ponting's film of Scott's last expedition. Commentary by Ponting, introduction by Teddy Evans.

Out of Sight, Out of Mind (colour, 1982). NZ film looks at history of Antarctic exploration. Includes stills and rare archival film of Scott, Amundsen, Shackleton, Byrd, Hillary.

Roald Amundsen (colour, 1975). British dramatisation of Amundsen's epic dash to the Pole.

Scott of the Antarctic (colour, 1948). Ealing Studio's depiction of Scott's fatal expedition of 1910-12. Stars include John Mills, James Robertson Justice.

Scott's Last Journey (colour, 1964). BBC film of Scott's expedition - the voyage south, winter at base camp, the journey to the Pole. Film and stills taken by Herbert Ponting, the expeditions's photographer.

Seige of the South (b/w, 1931). Footage by Hurley taken on Mawson's 1911-14 expedition, with commentary by Hurley.

To the South Pole with Peter Scott (b/w, 1967). Peter Scott retraces his father's route to the Pole in 1912. Contrasts difficulties of the heroic age with conditions of the 1960s.

The Years Back: The Big Ice (colour, 1973). History of NZ involvement in Antarctica from Scott's 1911 expedition to IGY is recalled in newsreels.

The 1940s, 1950s, and IGY activities

Address: Antarctica (colour, 1957). Scientists at work at Mawson in 1957 – Australia's contribution to IGY.

Antarctic Crossing (colour, 1958). Record of the crossing of the continent by the Commonwealth Trans-Antarctic Expedition of 1955-1958.

Antarctic Voyage (colour, 1957). The 1954-55 voyage to Antarctica of the Australian expedition aboard the *Kista Dan*.

Antarctica, 1948 (b/w, 1949). Record of Australia's two expeditions to Antarctic regions in 1948.

Blue Ice (colour, 1954). Record of the 1953-54 ANARE expedition which established the Australian base at Mawson.

Endeavour (colour, 1958). The NZ party of the Commonwealth Trans-Antarctic Expedition establishes Scott Base and restores the old huts of Scott and Shackleton.

Great Achievenment (colour, 1958). NZ participation in the Commonwealth Trans-Antarctic Expedition and IGY. Covers Hillary's dash to the Pole and his meeting with Fuchs, 1957.

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White Continent (colour, 1951). Record of the voyage of the Norwegian - British - Swedish Antarctic Expedition of 1949-52 and its first season in Antarctica.

Field work on the ice (Allan Brand).

Modern exploration and research

Above the Snow (colour, 1974). Planning and erection of Casey station in 1969, and life and scientific work there.

Antarctic (colour, 1976). Film by the US National Science Foundation showing international scientific research in Antarctica.

Antarctica (colour, 1980). A look at the life and work at Scott Base, and New Zealand's work in Antarctica. Film by NZ National Film Unit.

Australian Research in Antarctica (colour, 1975). Aspects of scientific research and fieldwork carried out by the Antarctic Division – medicine, glaciology, biology, physics.

Casey, Antarctica (colour, 1980). Brief history of Australian involvement in Antarctica. Shows life at Casey, an overland scientific travers and biological research on the coast near Casey.

Mawson Base: Face to Face (colour, 1984). Antarctica through the eyes of two expeditioners, the cook and the doctor. An insight into the daily pressures of life in isolation, narrated by Phillip Law.

Twelve Flags South (b/w, 1963). Details of scientific work in Antarctica by researchers of twelve nations.

Emperor chick keeps warm on its parent's feet (U.S. Navy photo, Quartermain Collection, Canterbury Museum).

Glossary

ablation zone	An area where ice or snow is melted or evaporated away by the wind.
ANARE	Australian National Antarctic Research Expeditions.
aurora	Moving streams of light in the outer fringes of earth's atmosphere, most frequently visible in the polar regions.
bed plate	Metal plate forming the base of an engine.
blubber	A layer of fat under the skin and over the muscles, which protects an animal from the cold.
crampons	Spiked metal plates worn on the boots to provide a better grip.
crevasse	A deep crack in glacier ice.
electrometer	An instrument which measures electric potential difference by the force of attraction between charged plates or needles.
frostbite	Inflammation of the body - especially hands, face and feet - caused by exposure to extreme cold.
furl	To roll up and bind a sail to a yard or boom.
geology	The study of the earth's crust. Someone who studies this is a geologist.
glacier	A mass of slow-moving ice, formed from many snowfalls.
glaciology	The study of the geological action of ice. Someone who studies ice and snow is a glaciologist.
hammock	A bed of canvas or netting, hung by cords at the ends.
hand	See 'furl'.
hoosh	A very thick soup or stew. It often contains pemmican.
ice floe	A large piece of floating ice.
ice shelf	A vast, level shelf of ice floating on the sea, fed by glaciers from the continent. The Ross Ice Shelf covers 500,000 square kilometres, and is up to 700 metres thick. Its front towers up to 60 metres above the sea; it used to be called an 'ice barrier'.
IGY	International Geophysical Year (1957-58).
isotope	The form of an element (such as oxygen) which differs from other forms in atomic weight and in its nuclear - but not chemical - properties. Radioactive isotopes break down at a set rate. They can be detected and measured and can show the age of things like rocks and ice.
krill	Small shrimp-like animals that live in the ocean. They are the main food of many larger sea creatures.
magnetician	Someone who studies magnetism and how it is produced.
marooned	Put ashore and left, as punishment.
meteorite	A fragment of rock or metal which has reached the earth from outer space.
meteorology	The study of the atmosphere, particularly for weather forecasting. Someone who studies this is a meteorologist.
naturalist	Someone who studies animals and plants.
ozone	A form of oxygen with three atoms in a molecule, more common in the upper atmosphere.
pack ice	Broken pieces of floating ice which form when storms or warmer weather break up the sea ice.

pelt	The skin of a fur-bearing animal, in this case a seal.
pemmican	Dried lean meat, pounded into a paste with melted fat. In the old days it was pressed into cakes, but later it was available in tins.
pressure ridges	Where areas of floating ice are pushed together (for instance, by a storm) they can form ridges where the ice floes buckle up.
promontory	A headland jutting into the sea.
reef	To reduce a sail's surface by taking in or rolling up part of it.
rigging	The ropes and spars (like masts, yards etc.) of a ship.
rookery	A colony of animals, in this case seals.
sastrugi	Wind-blown ridges on the surface of hard snow.
sextant	An instrument used in navigating and surveying to measure the angular distance of objects.
sheaves	The grooved wheels in pulley blocks used to hoist and lower a ship's sails and spars.
shrouds	Ropes which support a ship's masts.
snow-bridge	A layer of ice and snow that covers the opening of a crevasse.
snowblindness	Loss of vision caused by reflection of strong light from snow or ice damaging the eyes.
spade	A tool with a sharp, broad blade, in this case for removing blubber from whales.
spectroscope	Instrument for examining the spectrum - radiation (eg. light) which is arranged according to its wavelength.
stave	A short length of wood.
stay	A rope or other tie used to support or hold something on board a ship.
sub-Antarctic	The region of ocean encircling Antarctica, just outside the Antarctic Circle (66°33′ south latitude).
taxidermist	Someone who prepares and mounts the skins of animals.
theodolite	A surveying instrument, used for measuring horizontal and vertical angles.
trypot	A large pot used to extract oil from blubber by heating. The pot and associated gear is sometimes called the 'tryworks'.
vitals	The intestines, particularly the 'vital' parts such as lungs, heart, brain.
Weasel	Vehicle with caterpillar tracks for travel over ice and snow.

The front or "snout" of Canada Glacier, Taylor Valley, Victoria Land (Antarctic Division, NZ).

Antarctica: Discovery and Exploration is one of a series of sourcebooks which are part of the Pacific Circle Consortium's Antarctic Project. There are four storybooks:

The Adventures of Salik the Husky (8-10 years)
The story of a Greenland husky pup's voyage to Antarctica, and how he learns to be a sledge dog.

Rocky the Rockhopper Penguin (8-10 years)
The tale of a brave and inquisitive rockhopper, and the voyage from his Macquarie Island home across the Southern Ocean to Antarctica.

Oscar (10-12 years)
This true story tells of a husky named Oscar and his fight to remain "king dog" of the sledge team. He spends some time at the Melbourne Zoo and returns to spend his last days in the ice and snow.

Castles of Ice (11-13 years)
A true story of Antarctic adventure, "Castles of Ice" describes a sledging trip to the Douglas Islands and the difficulties and rewards of working in Antarctica.

Other sourcebooks in the series are:

Penguins (10-12 years)
Background information on penguins and case studies of three penguins - the Adelie, the emperor and the rockhopper.

Antarctica's Secrets Revealed (10-13 years)
This is in question-and-answer format, and provides a wealth of information aout the Antarctic continent.

Living and Working in Antarctica (11-14 years)
Why do people brave the ice and snow to work in the harsh Antarctic environment? Here are some of the answers.

Macquarie Island (11-15 years)
This Australian sub-Antarctic island is introduced, with information on its animals and plants as well as on human activities.

Campbell Island (11-15 years)
Campbell Island comes under New Zealand administration and is a meteorological base. The animals and plants are described and the effects of human interference are examined.

Oceanic Birds of Antarctica (11-14 years)
Case studies of three Antarctic birds - the south polar skua, the snow petrel and the Adelie penguin.

Learning Outcomes and Activities which can be used with these modules are included in the teachers' guide, **Teaching and Learning about Antarctica.**

For older readers:

The Polar Continent
Seals and Whales of the Southern Ocean
Antarctic Foodchains
The Scientist at Work
It Happened in Antarctica
From Snow to Icebergs
International Relations in Antarctica

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The *Nella Dan* sails through broken sea ice (National Library of Australia).